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HOW TO INSTRUCT

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INSTRUCTOR'S GUIDE

APR 13 1954

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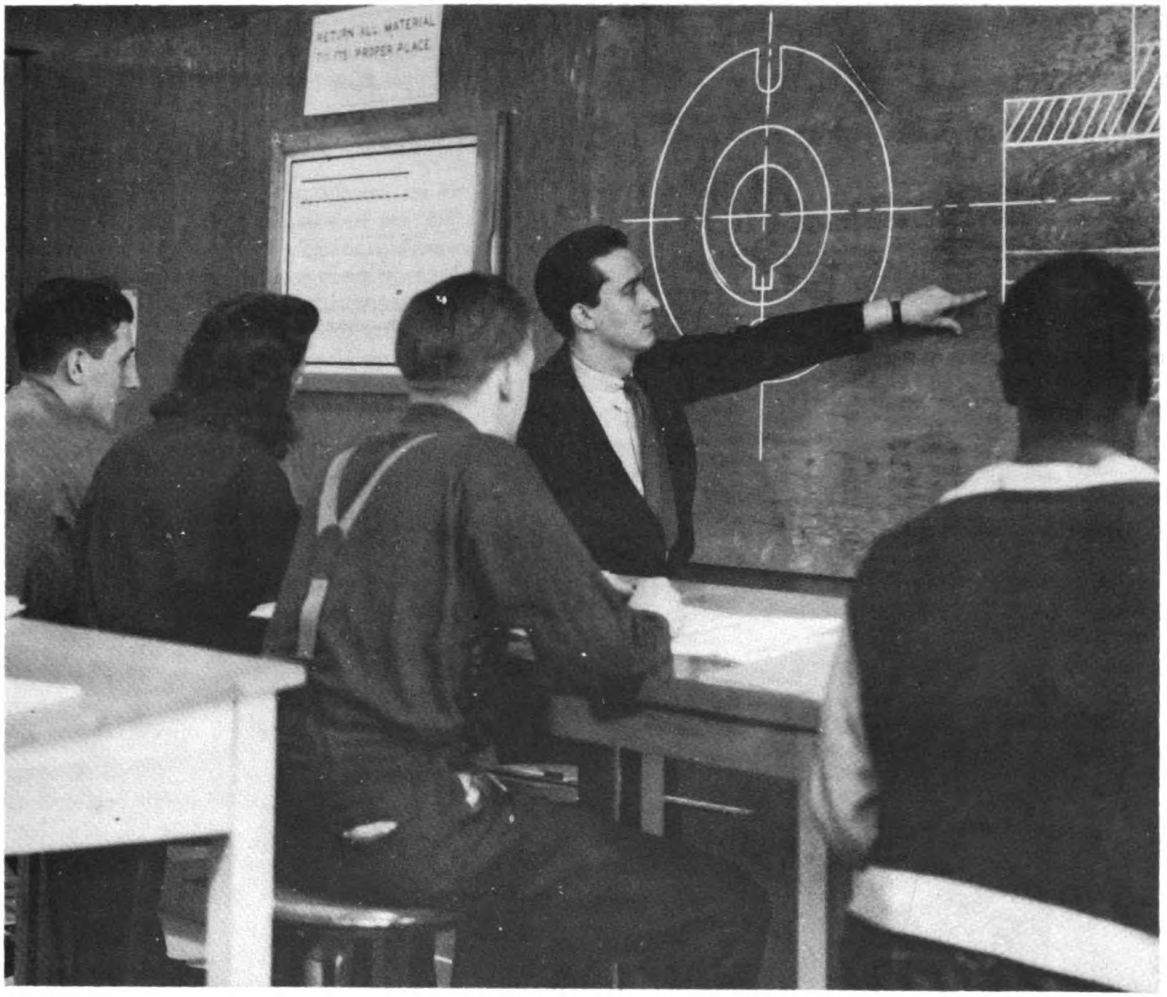
Chapter 1

THE INSTRUCTOR AND HIS JOB



The instructor looks at the duties and responsibilities of his job.

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THE INSTRUCTOR AND HIS JOB

Trainee: "How do you put this cotter pin in the support bolt of the landing gear?"

Instructor: "Oh, the usual way. You won't have any trouble with it."

Radio operator in plane over the air field: "Unable to release landing gear . . . running out of gas . . . coming in for crash landing."

Control tower at Depot: "Plane coming in for crash landing . . . Call ambulance . . . Call fire department."

Official report after investigation: "Crash caused by defective installation of landing gear. Employees inadequately instructed in proper installation of cotter pins."

You, as an instructor, are a vital part of our war effort. The increasing number of planes in the air is just as dependent on you as it is on the test pilot. Perhaps you don't want to bother with instructing, but would rather work on the planes themselves, or operate a teletype, or check depot supplies. Certainly these jobs must be done, and their connection with the war effort is direct and satisfying. But think for a moment of the tremendous importance of the instructor in providing a continuing supply of competent workers.

During the first years of the war, trained mechanics and office workers were available. Now inexperienced workers must be trained intensively for depot jobs. We cannot wait while they go through the usual apprenticeship. Instead, competent instructors must train them quickly and efficiently in certain specialized jobs.

No matter what you are called on the job—supervisor, foreman, shift leader, associate instructor, or principal supply officer—you will be considered an instructor in this book. Thinking of yourself as an instructor reminds you of the constant challenge to help other persons develop.

The backbone of any training program is its instructors. If they understand their trade and speciality, and if they apply the principles of teaching and learning, the training program will be good. From their classes will come a stream of capable workers to keep the planes flying and fighting.

I. YOU, THE INSTRUCTOR

You, as an instructor, are part of a long and honorable tradition in education that has centered largely in the formal learning of the schools. But you are also a part of a new and growing movement in the teaching of skills by which men earn a living. These skills are now taught on the job as well as in organized schools. Your employer or foreman probably showed you what to do on your first job. One of your fellow workmen may have helped you to avoid mistakes or to do your work more quickly. Whenever anyone has helped you to learn, he has been acting as an instructor.

A skilled workman is likely to become a foreman if he can help others to learn and to work efficiently. If you have these characteristics, you may become an instructor. To the skills you already have, you will need to add the skills of a new profession—that of the instructor. Both the instructor and the workman need to be able to get along with people. Both need to plan their work. But there are several interesting differences in their responsibilities, which appear in the lists of figure 2.

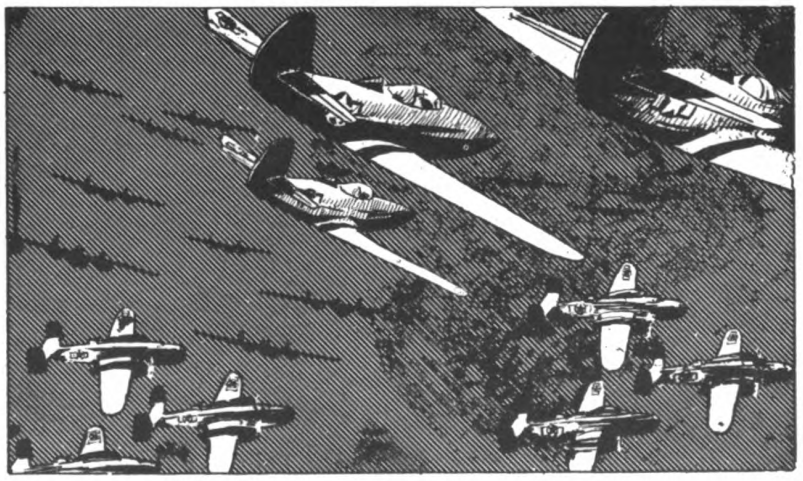

Figure 1—Keep them flying and fighting

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MECHANIC

1. **Makes** the product.
2. Works with specialized equipment: machines, tools, etc.
3. Requires specialized skill.
4. Requires specialized knowledge.
5. Requires integrity, steadiness, and loyalty.

INSTRUCTOR

1. **Trains others** to make it.
2. Works with the same equipment **plus** untrained, or partially trained, enrollees.
3. Uses same skills **plus** skills of instructing others.
4. Uses same knowledge **plus** knowledge of how people learn.
5. Requires same characteristics **plus** leadership, patience, and ingenuity.

Figure 2—Comparison of the duties of mechanic and instructor

Most of you are competent workers in some specialty, such as repairing radial engines, running a teletype, or checking depot supplies. Like the man carrying the tools representing his specialty in figure 3, you carry your tools with confidence in your stride. Going through this manual carefully may be like going through the "Instructor Training" represented by the building in the same picture. Inside your brief case, you may have information about instruction that you can use every time you help a fellow worker or trainee, and every time you talk to a group in a classroom or around a machine.

In your specialty, you use your tools skillfully, whether they are screw drivers, dope guns, lathes, typewriters, or filing folders. In your instruction, you should be skillful with the "tools" of teaching. You will teach better if you know something about how people learn, what methods are best for certain kinds of instruction, whether to use the blackboard or mimeographed job sheets, and how to make up tests. These are some of the tools of the instructor's trade.

IF YOU CAN DO A JOB WELL, AND TEACH OTHERS HOW TO DO IT WELL, YOU ARE ABLE TO RENDER A DOUBLE SERVICE.

Among the new adventures you will have as an instructor, will be the discovery and use of your new tools. You will find out the scientific way of breaking down a trade into small enough parts so that the trainees can learn easily. You need to know how we learn, and how to plan and teach in different situations. You can discover how to use instructional aids that will help make your instruction interesting and impressive. You will find good ways of managing a group of trainees in a shop or classroom, and of checking up on them to see that they are doing a good job. In this manual, you can discover the suggestions which good instructors use constantly in their work.

II. WHAT AN INSTRUCTOR DOES

You may think of yourself as instructing only when you are actually working with the trainees in a particular lesson. It is true that talking to them, showing them how to do something, and checking up on what they do, are important public evidences of your teaching. But what goes on behind the scenes is equally important.

AT THE DESK: Let us look at the things you will be thinking about and doing outside your classroom or shop. In planning for your instruction, you will organize what you are going to teach, select the method and visual aids so that you can teach it well, and make up tests to check the learning of the trainees. At other times, you will be keeping records and reports of the trainees' work.

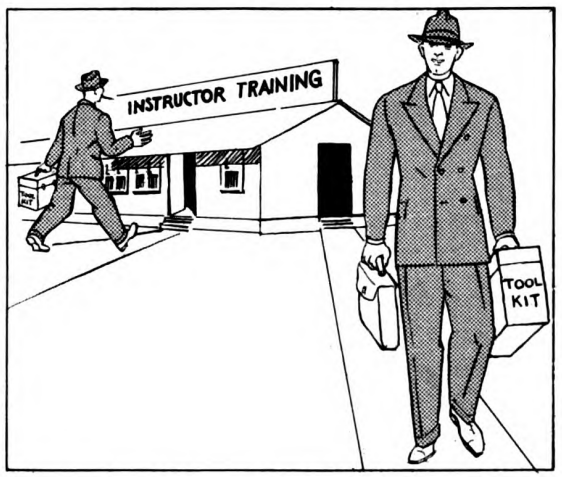

Figure 3—The mechanic gets his second kit of tools

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IN THE CLASSROOM: During the actual period of instruction, you will be preparing the trainees for their learning by introducing some interesting story or bit of information; you will be telling or showing them what you want them to know; you will be helping them to apply their new knowledge; and you will test them to see how well they remember it.

IN THE SHOP: In addition, you are responsible for the management of your shop or classroom. The upkeep of machines, the care of supplies, and safety provisions are all under your direction. As in housekeeping and plant management, a well-organized shop or classroom is an indication of an efficient worker.

III. WHY TEACH?

INDIVIDUAL GROWTH Teaching is mentally stimulating. It challenges you to know your occupation thoroughly and to keep abreast of the new developments in it. Besides, you learn to handle all kinds of people in dozens of different situations by being tactful, firm, or pleasant. In brief, you acquire social skills based on human understanding, in addition to your trade skills.

SATISFACTION Teaching gives satisfaction because it is an interesting job. Since you are dealing with human beings, your work will be infinitely varied. What you teach, and particularly how you teach it, is dependent on the trainees as well as on the general outline of the course. For example, compare teaching with writing military letters in which you are bound to use the same form. In teaching, you can and must use *different* methods according to the subject matter and the trainees. Every day, every class, or every trainee presents a problem for you to solve. Your job requires ingenuity, not routine; hence it is interesting, not monotonous.

Another satisfaction in teaching comes with your pride in your trainees. As you watch them acquire skill, develop self-confidence and pride in their work, you feel a definite glow of pleasure in their achievement. You know that they are more efficient workers, and perhaps better persons, because of your help and influence.

MONEY You had better face the situation honestly: the reward for teaching does not come in a pay envelope. To be sure, you will earn a respectable salary, which will enable you to live on the same level as your fellow instructors. If you return to industry after the war, your skill in teaching will make you a more valuable man in the plant. But if you continue as an instructor, you must accept the facts that teachers usually live in comfort rather than in luxury; and that they accumulate wisdom and rich experience rather than wealth.

WAR SERVICE In teaching lies your opportunity to serve effectively in the war crisis. It is just as important to have men trained for the maintenance and repair of airplanes, as it is to have the materials for their production. If you were an inventor, you would be working on the machines of war. Since you are a potential instructor, you can teach men and women to maintain some of the machines of war.

Learning to be a good teacher is to your personal advantage. More important, it fulfills your obligation to your country in time of need. Every man, woman, or child living in the United States is under obligation to do everything in his power to aid in the war effort. Whatever sacrifices we who stay at home may make, whatever added obligations we may assume in order to aid in the war effort—these are mere gestures by comparison with those of the men who are giving everything they possess in order that this freedom of ours may continue forever. Each of us can make some small contribution and thus help to end the war sooner. Perhaps your job is to train others to do the kind of work which you are doing. This will mean extra study and work on your part. Are you willing to do your share?

QUESTIONS

(1) Show how your work as an instructor is important to the Air Depot and to the war effort.

(2) Compare the duties of a skilled mechanic with those of an instructor, giving four ways in which they are similar, and four ways in which they differ.

(3) Compare "doing the job you know" with "instructing others in how to do it."

(4) What part of your work as an instructor do you expect to do at a desk? In the classroom? In the shop? How could you get along satisfactorily if an actual desk were not available?

(5) Name four advantages of the occupation of instructing. Which of these is most important to you? Why?

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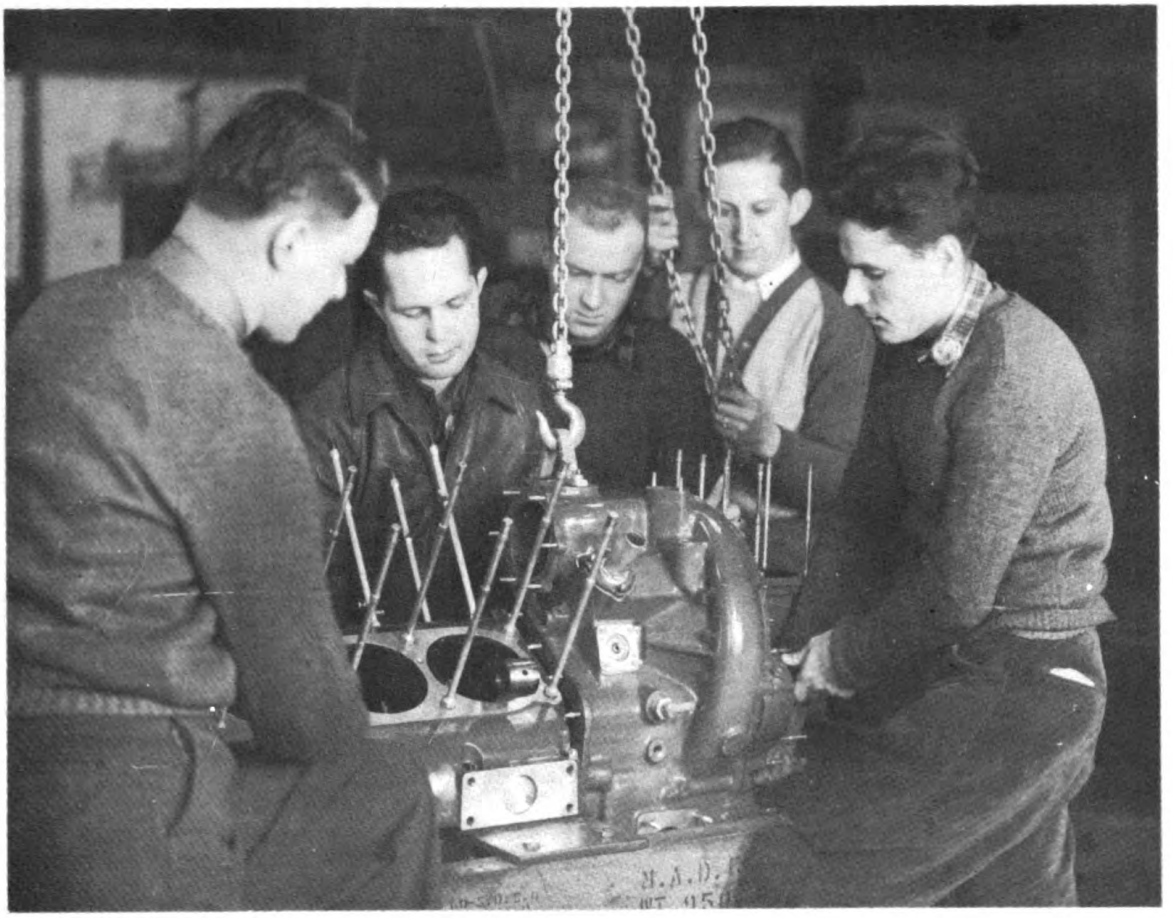
Chapter 2

HOW TRAINEES LEARN



The instructor looks at some of the factors which affect learning.

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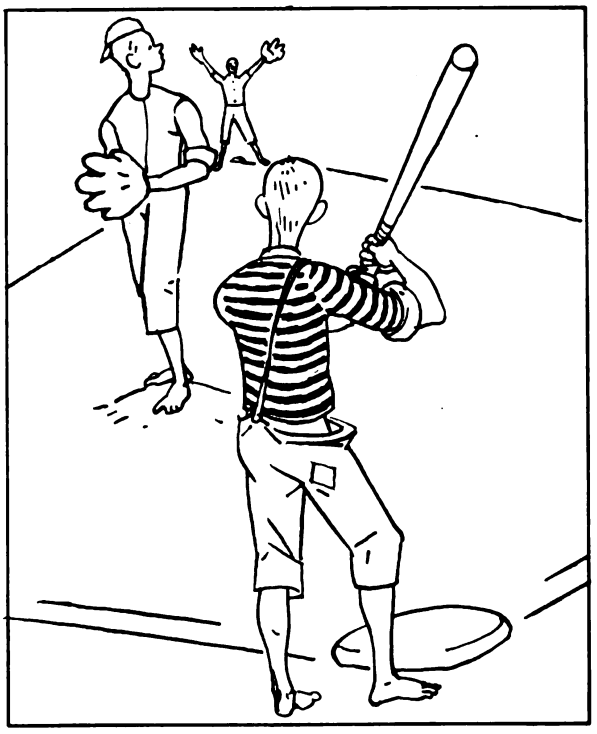
HOW WE LEARN

All your life you have been learning, whether you were in school, at home, on the playground, or by yourself. Sometimes, you were learning new things, as when you began to study fractions or to ride a bicycle. At other times, you were *repeating* your newly gained knowledge so that you would never forget it; for instance, you said your multiplication tables over and over again so that you remember them to this day.



Whenever you have learned something, you have used your mind. Even when you learned to play catch with a ball, you were using your mind to tell the muscles in your arms and fingers what to do. At first you had to *think* about it or the ball would skim past your outstretched hands; after some practice you could catch the ball almost automatically. More than that, you were using your eyes and other senses to help you learn. You watched the ball fly through the air and learned to judge its speed and its distance from you at any instant. Through your sense of feeling you learned that a fast ball would hurt your hand unless you had a glove on, and that a slippery ball was hard to throw accurately. The sound of a ball as it was struck by a bat often told you whether or not the ball was hit squarely.

As a teacher, you will be working with the minds of the trainees as well as with their hands, for the mind governs the hand. You will be helping them to become sensitive to the sights, sounds, and feelings which will make their learning more solid. In addition, you can probably remember devices and techniques that helped your learning and will help your trainees.

Do you remember how much easier it was to learn a new thing if it was related to something you already knew? It was easy to remember how to spell "Philadelphia" if your friend lived there. Baseball was easier to learn if you had already played catch.

If you have ever tried to learn something when you did not understand it, or when you did not like it, or when you did not want to learn it, you are on the trail of other important principles of learning. Your teacher got the best results in your penmanship when you understood why you should learn to write well, and when you wanted to learn to write well. She could not make you learn unless you wanted to. If you liked her or the school or your classmates, your learning was much more rapid; and if you were satisfied with your improvement and perhaps praised for it, your penmanship became considerably better.

You found that you could not learn to write by watching the teacher write on the blackboard or on a piece of paper. You had to write for yourself. Anything that you wanted to do well, you actually had to do; you could not learn to sail a boat or kick a football or make a speech by watching someone else. Your learning may begin with seeing someone do a thing, but you must try it for yourself to perfect that learning; or, your learning may begin by reading books, service manuals, or newspapers. Men often get ideas by talking to other men in their trade; women learn new recipes and household suggestions by listening to the radio.

Some of your learning was organized, as in school. Much of it was picked up as you ran into new situations. Out of the memory of your own learning, you have found the principles of learning which are true of all of us:

(1) We get our new impressions from seeing, hearing, and feeling—in other words, through our *senses*.

(2) We tie up the new information or ideas with something we already know.

(3) We learn best when we are ready to learn.

(4) We usually understand the purpose for which we are learning new things.

(5) We first get an understanding of the thing we are learning, and then learn to do it by actually doing it.

(6) We become skillful through practice.

(7) Our learning sticks with us better when the results are satisfying to us.

(8) Things which we must think about when we first do them may become automatic with practice.

(9) Our feelings have considerable effect on our learning.

These are some of the fundamental principles which underlie all learning. As an instructor, you will need to know them. Remember that teaching is simply helping other persons to learn.

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Figure 4—Seeing

Figure 5—Hearing

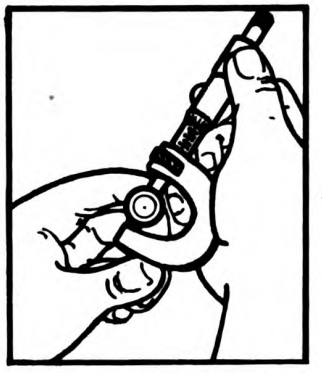

Figure 6—Feeling

Figure 7—Smelling

I. HOW LEARNING BEGINS

A. LEARNING BEGINS WHEN WE SEE, HEAR, FEEL, SMELL, OR TASTE SOMETHING.

All of these experiences of the senses make impressions on our minds. Even now, you can remember the strong impressions of your childhood, such as your first sight of a strange city or the sound of a machine gun in the movies. Seeing and hearing are the senses most often used in learning. Less important are feeling, smelling, and tasting.

Since getting an impression is the first step in learning, you want to understand exactly how trainees can be given strong impressions.

Most of our new impressions come through the eye. The printed page of book or newspaper, the picture on the screen, writing on the blackboard, a chart or diagram, a machine in operation—these and hundreds of other impressions come to us in a classroom or shop because we can see them. Eyes, then, are all-important. If what we see is clear and vivid, we learn more effectively.

Hearing is next in importance to seeing, in the impressions we get. The radio, the voice of the instructor or of a fellow workman, the steady purr of a well-timed engine, the chatter of a cutting tool, the rattle of a loose bolt—sounds like these come to have special meanings to the trainees who have listened to them.

We learn more through our sense of touch or feeling than we would ordinarily believe. The "feel" of a micrometer or the "drag" of a caliper means something to the machinist.

The "touch" of the typewriter, the tightness of a bolt, the roughness of a surface, the vibration of a machine are impressions that may be connected with our learning. For instance, we soon learn how the steering wheel feels when one of the front tires on the car begins to go flat.

Less important are smell and taste in giving us impressions that are important for learning in the classroom or shop. The electrical worker soon learns the meaning of the smell of burning insulation. The odor and taste of food are likewise important to the cook.

These messengers of the mind—seeing, hearing, feeling, smelling, tasting—give us impressions. If two or more kinds of impressions arrive in the brain at the same time, we learn more easily. For example, if an instructor tells us about a machine at the same time that we watch it work, we learn more quickly than if we hear about it without seeing it. It is also true that some single impressions are more vivid than others. You may not remember a black-and-white picture of the Grand Canyon of the Colorado; but the same picture tinted would probably stick in your mind. We learn best, then, if the impression is vivid, and if it comes through two or more of our senses.

B. LEARNING IS ALWAYS BUILT ON WHAT WE ALREADY KNOW

Learning is like building a house—we start with the foundation rather than with the roof. We cannot build the roof until the walls are there to support it. In learning, we start with the simple, fundamental knowledge before we go on to new and difficult problems. Before we can do stunt flying, we have to master ordinary flying.

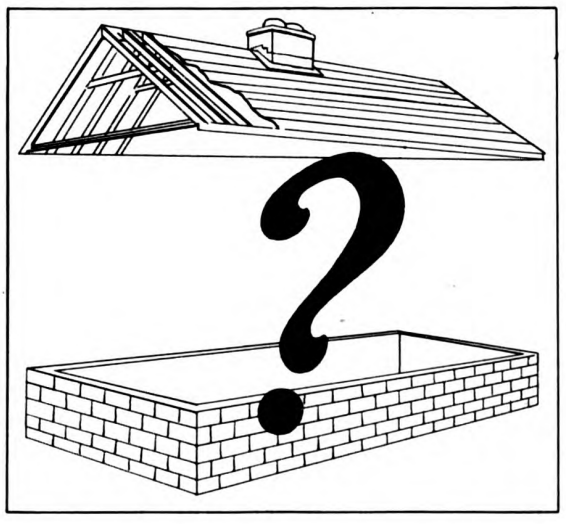

Figure 8—Start with the foundation and build upward

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In other ways, too, learning is like building. It takes place step by step, with new material fastened to what is already there. Each brick added to the wall must be fastened to the next brick with the right kind of mortar. The right kind of fastener must also be used whenever we learn anything. For example, if someone tells us how to handle the controls of a plane, we are not immediately competent for a solo flight, because the learning was not fastened adequately. Other and better fasteners are needed, such as Link trainers and training planes which give beginners a chance to learn by doing.

When we add a brick to the foundation wall, we use mortar on as many sides as possible. If it is fastened on one side only, the first push might tumble it off. With bricks attached firmly by the side, bottom, and ends, the wall will stand up under pressure for many years.

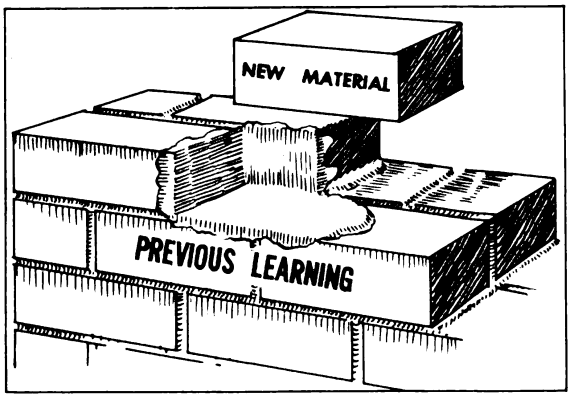

Figure 9—Good bonding makes a sturdy wall

So it is with learning. We should fasten every new bit of learning with as many connections as possible. Seeing something provides one connection, hearing about it gives us another, and doing something with it gives us a third. These different ways of fastening the new impression to what we already know help us to learn more surely than if we got the new idea in only one way. The more connections we make, the longer we can remember what we learned.

II. HOW TO STRENGTHEN LEARNING

Getting many of the right kinds of clear impressions provides the framework of all learning. To make it really effective, however, this framework of learning needs to be supported and protected in many ways. Are your trainees interested in their work? Do they understand how today's job fits with yesterday's or tomorrow's work? Do they have a chance to try out their new knowledge? Are they developing good work habits? Do they solve problems well? Are they characteristically good humored? An affirmative answer to these questions means that you are giving your trainees a good break, that their framework of learning is strengthened as it should be. Perhaps you would like to know more about these ways of improving learning.

A. GIVING THE LEARNER AN INTEREST IN HIS WORK

When Billy Mitchell enthusiastically tried to convince Americans of the importance of planes in modern warfare, his arguments fell on deaf ears. People were not interested in the preparation of equipment for a distant war. Within the last few years, however, almost everyone has taken an interest in airplanes. Youngsters build model planes, grandmothers in air depots stitch fabric covers for plane rudders, and millions of our young men and women now know as much about planes as about automobiles.

All of this new learning about planes has come about because we *wanted* to learn. The danger of attack, the need to protect our ground troops, the opening of new and good jobs, the excitement of flying—these are some of the reasons for our interest. Because of them, *we are now ready to learn,* and we have what the psychologists call the proper "mind-set" for learning.

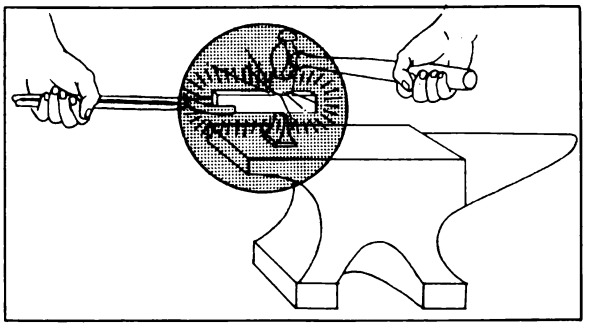

Figure 10—Strike while the iron is hot

How can you use the interests of the trainees to help them learn? Just as a blacksmith heats his metal before forging it, you must warm up the interest of your trainees in what they are to learn. For this purpose, you can use any number of incentives. The trainees may want to get better jobs, or they may want to please you or their boss. You may be able to rouse their curiosity about something new, or to link the necessary elementary information with advanced work which interests them. When they are completely warmed-up and ready to learn, they have the proper mind-set for learning.

Sometimes they will be all warmed-up at the beginning of a class or shop lesson, and then their interest will die as the session goes on. If they are to continue to learn, somehow they must get warmed-up again. Since most trainees have these ups and downs in interest, a good instructor learns how to keep them in good mental condition for learning by generating new interests as the learning progresses.

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B. SHOWING THE LEARNER THE RELATIONSHIP BETWEEN HIS JOB TODAY AND THE PATTERN OF THE WHOLE

For want of a nail the shoe was lost,
For want of a shoe the horse was lost,
For want of a horse the rider was lost,
For want of a rider the battle was lost,
For want of a battle the kingdom was lost—
And all for the want of a horseshoe nail!

If the blacksmith had understood why it was important for him to do a good job, the kingdom might have been saved. Your trainees, similarly, have heavy responsibilities to do good work if loss of life and equipment is to be avoided. If they are learning welding, they should understand how a poor weld can weaken the structure of a plane so that it might crack up under the stress of battle. Moreover, they should understand how the welding of "chromemoly" tubing is related to the welding of motor mounts in the finished plane. Anyone does better repair work if he understands how his job fits in with the rest of the repair jobs, and why it is done in one particular way. Learning is improved when trainees see where each specific bit of information, or each specific operation fits into the whole pattern.

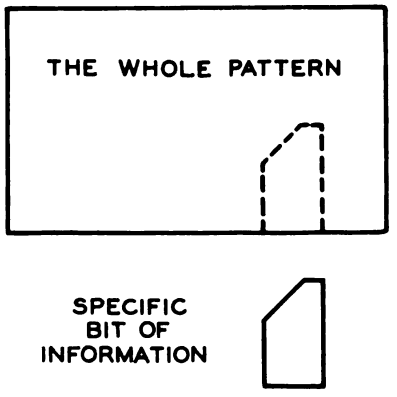

Figure 11—The relation of today's work to the whole pattern

Some persons who work on routine jobs which they do over and over may not be concerned with seeing how every detail of their work fits into the details of the other jobs. But for most trainees, knowing the relation between their job and the finished product is important. Even the maker of a special type of bolts would probably be interested in knowing where those bolts were to be used. If you give your trainees some idea of this larger pattern into which their work fits, they will not only be more interested—they will also work more intelligently. For they can then know which parts of their work are the most critical or important, and why certain operations must always be done in a certain way.

C. UNDERSTANDING WHAT WE LEARN

It is difficult to teach a child not to touch a hot stove because he does not really understand what it means to be burned. Once he understands, his learning of that particular fact is permanent.

Grown-ups need to understand more complicated facts. If they do not, they too may get burned in one way or another. When a trainee simply memorizes principles, formulas, laws, and symbols, he may not know what they mean. He is like a parrot whose repetition of certain words is useless because they are meaningless to the bird. The danger lies in the fact that the trainee often cannot use the memorized information in any situation which is different from the one which he learned. For example, a trainee might learn to write the symbols used in a schematic drawing of an electric circuit, showing a switch, a battery, and a lamp, (figure 12); but each of these symbols must mean something to him (figure 13), if he is to understand how to use the drawing. Otherwise, he would not have learned.

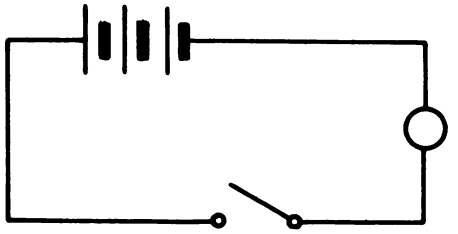

Figure 12—Symbols showing electric circuit

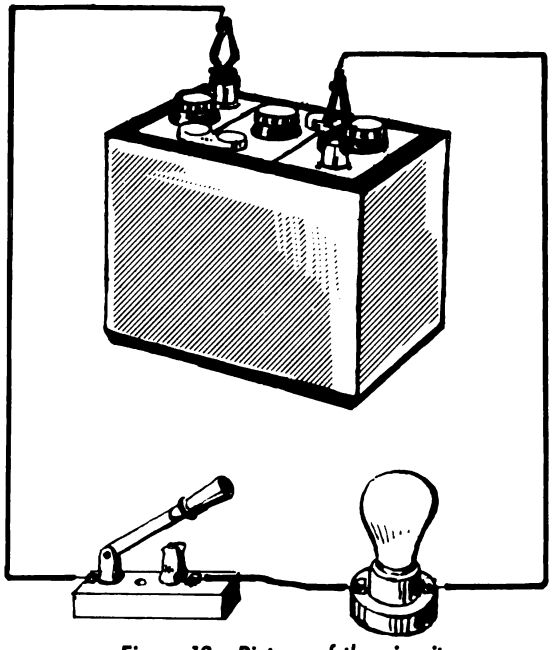

Figure 13—Picture of the circuit

If the trainee understands the purpose or meaning of what he is doing, he can readily adapt his skill to new situations. For example, a trainee who understands the diagram of the electric circuit could substitute a receptacle for an electric fan in place of a lamp bulb. Because he understands what he has learned, he is not limited to the exact situation in which he first gained the skills or information.

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D. LEARNING BY DOING

Have you ever heard someone say, "I've *told* him and *told* him, but he won't learn to do it right." Although the learner in such a situation appears stubborn, he may need more than telling if he is to do the job right. THE BEST WAY TO LEARN HOW TO DO SOMETHING IS TO DO IT. Even simple jobs like hanging up clothes, or polishing shoes, are best learned by doing them at least once. The *expert* laundress and the shoeshine boy do their jobs over and over, and become more skillful than the average person who does the same simple job. The secret lies in *doing* the job they are learning.

Simple jobs around the depot, too, are best learned if the trainees are given a chance to do them. Suppose someone who was being trained as an inspector had to know how to open and how to check the operation of the emergency exit in a plane. He could read in a Technical Order:

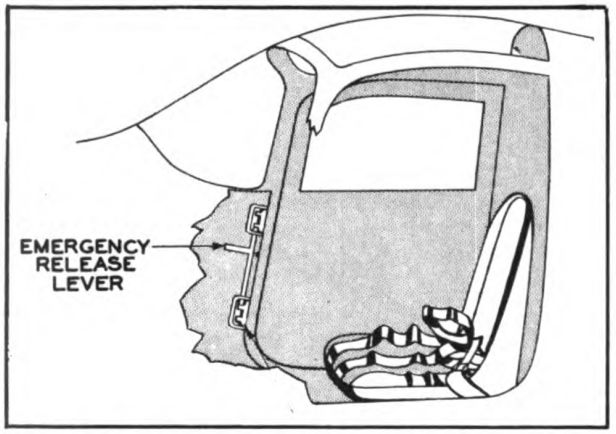

Figure 14—Learn to release the door by actually doing it

"A cabin door 'Emergency Release' lever is located just forward of each cabin door, painted red, and is operable by the pilot. Pulling the door 'Emergency Release' lever aft, instantly, disengages the cabin doors."

Or, an instructor might give him about the same instructions. He might see an emergency exit made in a moving picture; but until he actually opened the emergency exit, he would not feel that he had learned how to do it.

To do a more complicated job well, the learner must do it over and over. Once is not enough. For instance, watching a swift typist might make us think that operating a typewriter is easy. When we sit down to try it, we have to look for the letters. Sometimes we hit the wrong letter, or forget to space. Certainly we do not write very fast. At last, we realize that he have not learned by watching the typist. Nor have we become skillful in this complicated job by trying it once. We would have to learn it by doing it—again and again.

Even ways of doing things with the brain as well as with the hands have to be tried in actual practice. If you showed some trainees how to do a problem in mathematics, they might think they knew how to do it.

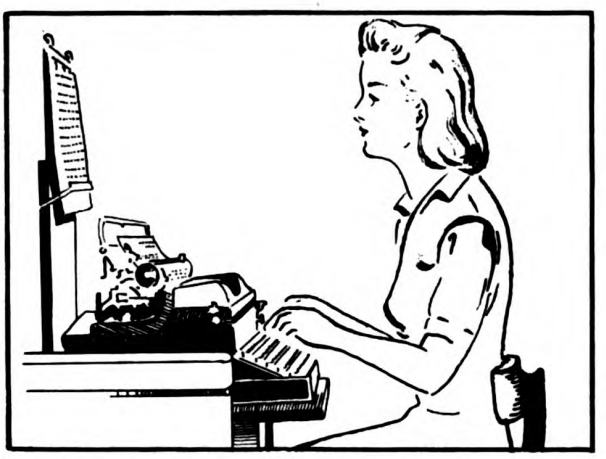

Figure 15—The typist learns by doing

But some of them might get stuck when they tried it. They might puzzle out the difficulty or get you to help them. After a while they would solve the problem, though they might have to do it over and over to be sure they knew how to do another like it.

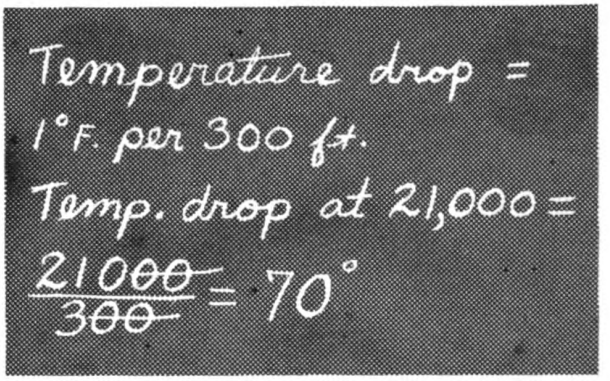

Figure 16—Solving a problem

"I've told him and told him" is not enough. Whether a beginner is learning to do something with his hands or with his mind, he needs to go through the process once if it is a simple one, and more often if it is a complicated one.

E. DEVELOPING GOOD WORK HABITS

A trainee has some good work habits if he begins work promptly, is careful with the material he uses, keeps his machines in good condition, and puts away his tools when he is through with them. He may be in the habit of handling a rivet gun, teletype, or mimeograph properly. Any of these work habits not only make him more efficient in his work, but they also help him to learn more quickly and to remember what he has learned. Since good habits are so useful, knowing how they develop is important to all instructors.

Habit formation really begins when a trainee learns to do something by actually doing it. The first few times he goes through the procedure, he has to think about what he is doing in order to do it right. After he

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has done it the same way again and again, he no longer has to think about it. For him, the procedure has become a habit. Like many other things he does, he need not figure out how to do it every time. He multiplies 2 by 2 automatically, he takes the short cut to the store without thinking about it, and he shifts gears on his car without puzzling out each step. If he had to think about all these details, he would not have time to learn anything else. On the job, too, when the simple processes are habitual, the trainee is free to learn more advanced work.

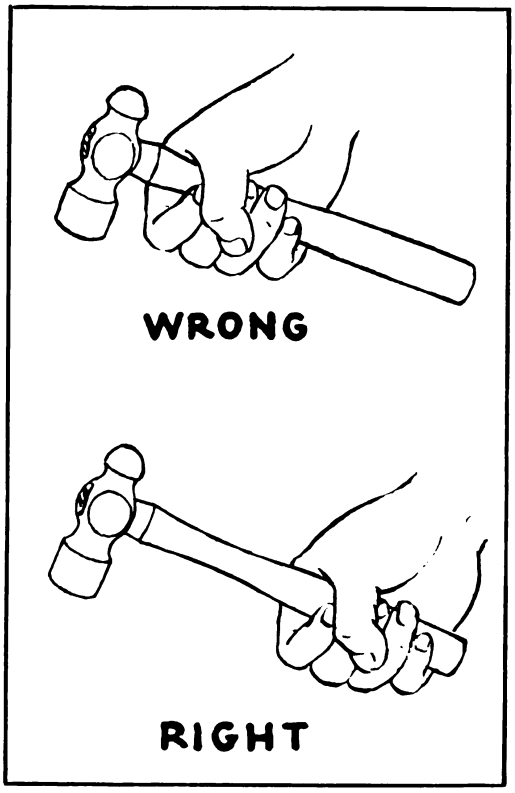

Figure 17—Hold the hammer the right way

Your trainees will develop good habits more quickly if they follow certain principles:

(1) **Get started doing the thing right.** (If trainees get started in the wrong way, they may develop a bad habit which is difficult to change. For example, a workman who habitually "chokes" a hammer may have some trouble in learning to hold it at the end of the handle.)

(2) **Do it always in this same way.**

(3) **Do it over and over,** until the habit is firmly established.

Habits may be of thought or of action. We are most familiar with habits of doing something. For instance, the stenographer is in the habit of hitting certain keys with certain fingers. She started by learning where the keys were, and which finger to use for each one. She practiced typing until she no longer needs to think about which finger to use. If she is skillful, she thinks only about the material she is copying. The typing has become a habit.

Mental habits are familiar to us in our friends. One may be a "yes-man"—in the habit of agreeing with everyone. Another may be in the habit of arguing about everything. More complex mental habits are encouraged for good work on the job. The stenographer, for instance, has formed certain mental habits in working out her tabulations and margins. A good mental habit for everyone is the method of problem solving outlined in the following discussion.

F. THINKING THROUGH A PROBLEM

What happens when you think? If you have a problem to figure out, do you rush into it without considering all the angles? Or, do you go around in circles, covering the same ground over and over, finding the decision more and more difficult to reach?

Good thinkers apply their past experiences to new problems in a systematic way. Below is a list of steps recommended by Prosser as a good method of solving a problem.

(1) Whenever you tackle a matter, spot your problem first.

(2) Analyze it so as to find out what facts bear on it that count.

(3) Take stock of the facts you already know.

(4) Get the facts you need but do not know.

(5) Put them together so as to get your stock, your kit of facts, for thinking.

(6) Run these facts through the mill of your mind; compare, contrast, weigh, eliminate, accept, reject.

(7) Make decisions on the basis of your conclusions.

(8) Organize these decisions into a plan.

(9) Put over the plan by carrying it out.

(10) Inspect the results. If the results are good, the facts are correctly chosen and your thinking is straight. If your results are unsatisfactory, either one or both of these contingencies are not true.

These steps can be useful in solving all sorts of problems. Personal and family problems can be approached in this way. Scientists and engineers frequently tackle their intricate problems in this general way. A supervisor of repairs, inspection, or replacements can consider any one of his problems according to this pattern.

For example: A trainee may be familiar with the removal of the storage battery of an automobile, but he may not have the slightest idea of the procedure used in the removal of the aircraft battery. Here he can apply the ten-step procedure for solving the problem similar to the following, and arrive at a conclusion step by step.

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(1) Problem: To remove battery from airplane without damage to either.

(2) Facts that bear on the problem:

a. Where is battery located?

b. How is it fastened?

c. Is it spring-loaded?

d. What precautions must be taken before disconnecting it?

e. What precautions should be taken after disconnecting it?

(3) Known facts:

a. Battery is heavy.

b. Battery is filled with electrolyte.

c. Care must be taken to prevent electrolyte from spilling.

d. All switches must be turned off before disconnecting the battery.

(4) Get facts needed from Instructional Manuals:

a. Location of battery.

b. Manner of fastening.

c. Presence or absence of vent tubes.

d. Presence or absence of spring loading.

e. Presence or absence of hold down straps.

f. Tools to be used.

g. Cautions to be observed.

(5) Assemble known facts and other facts procured from Instructional Manuals.

(6) Run these facts through the mill of your mind; compare, contrast, weigh, eliminate, accept, reject.

(7) Make decisions.

(8) Organize these decisions into a plan. (The plan will vary with different airplanes.)

(9) Carry out the plan. Remove the battery.

(10) Inspect the results:

a. Was any damage done to battery or airplane?

b. Was removal made in such a manner that installation of another battery will present no additional problems?

Anyone, then, will find this method of problem-solving useful. You may learn to depend upon it in decisions about your instruction; you will be doing your trainees a good turn if you pass it along to them, and give them practice in using it.

III. FEELINGS THAT HELP OR HINDER LEARNING

"I didn't feel like it" is a favorite alibi for not knowing or not doing something. Actually, it may be a true explanation. If you don't feel like teaching, or if your trainees don't feel like learning, the odds are against successful instruction. On the other hand, if you and the trainees feel like getting down to brass tacks, they can learn much in spite of poor equipment or unfavorable conditions. Perhaps some understanding of the way these feelings can work for or against learning will help you in your instruction.

A. FEELINGS THAT *HELP* LEARNING

(1) *Satisfaction or pride in our work* makes us want to learn and to do our work well. This feeling may come simply from our respect for the job we are doing and the belief that it is vital in the war effort. Or, it may come from the satisfaction of achieving success in our efforts, and thus being encouraged to aim at higher goals. If an employer or instructor praises our work, we begin to feel proud of it. Often this pride makes us want to keep up our standards. For example, in some plants engaged in war production, the workers take pride in producing work to more exact measurement than that specified in the working tolerance.

(2) *Curiosity* makes us want to learn how something works, or how we can find the answer to a problem. Most of the mechanical workers at the depots may be interested in finding out what makes some particular part of a plane tick. Clerks in Headquarters and depot supply may be curious about how such a complicated program is organized to provide for the many activities of the depot.

(3) *Enjoyment* that comes with working and learning in a "good gang" helps us to learn faster. A football team, for instance, has little trouble learning signals, partly because all players feel as if they *belong* to the group. Also, if the trainees like you as an instructor, they will learn faster because they will want your respect and approval.

(4) *Good physical health and good working conditions* bring about feelings which help learning. Though we hardly realize it, good lighting, comfortable temperatures, and convenient arrangements of desk or machines improve our work.

B. FEELINGS THAT *HINDER* LEARNING

(1) *If we are bored* by long-winded lectures or inactivity, our learning slows down. For example, trainees who needlessly wait around for something to do are often reluctant to learn when the material, equipment, or instruction is finally available.

(2) *If we are afraid* of doing something wrong, or of getting hurt, or of failing, our work and our learning suffer.

(3) *If we feel inferior,* and if we are convinced that our learning is always slower than in the case of the others, we actually are not able to learn as fast as we might.

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(4) *If we worry* about family problems, or about money, or sickness, we are distracted in our learning.

(5) *If we are in poor physical health,* or if we work under poor conditions, our learning is likely to be hampered by feelings of discomfort.

As an instructor, you are interested in these feelings from two angles. Your work will be at its best if *your* feelings encourage you to learn how to instruct effectively; and your trainees will progress more rapidly if you can develop *their* feeling of enthusiasm for their work.

IV. LEARNING DIFFICULTIES WHICH TROUBLE TRAINEES

At one time or another, most of us have run into learning difficulties. If you have ever found it hard to learn arithmetic or spelling, or to write compositions, you will be sympathetic with the problems of your trainees. When a trainee has trouble learning something, you should be able to recognize the difficulty and help him overcome it. Below is a list of some of the general and particular characteristics of learning difficulties. Throughout the book, and particularly in Chapter 6, you will find remedial suggestions for trainees with one or several of these troubles.

A. Some trainees who lack the ability to retain knowledge:

(1) Are slow to pick up information.

(2) Find it difficult to concentrate on assignments. These qualities (1 and 2) are likely to be found among older trainees.

(3) Do not have the mental equipment to do the work.

(4) Have physical handicaps, such as deafness, poor sight, or stuttering.

(5) Lack the muscular control necessary to develop certain skills.

(6) Have a tendency to jump at conclusions, and close their minds to any other possible explanation.

B. Some trainees who do not organize or evaluate well:

(1) Have trouble in tying related facts together.

(2) Have too many other interests to think about their class or shop work.

C. Some trainees who fail to apply themselves:

(1) Do not do their homework.

(2) Are just plain lazy on the job.

(3) Have allowed themselves to get rusty on background material they should know thoroughly.

D. Some trainees whose attitudes hinder learning:

(1) Are easily discouraged.

(2) Are too much embarrassed to ask questions when they do not understand.

(3) Have the feeling that they cannot do their work.

(4) Do not see the value of what they are learning.

(5) Lack interest in the work.

(6) Are too shy or quiet to take part in class discussions.

(7) Are "wise guys" who try to show themselves off, or to show-up the instructor.

(8) Do not like the instructor because they think the instructor dislikes them.

(9) Are competitive and race ahead of the group and the instructor.

(10) Think the instructor does not know his stuff.

(11) Are "yes-men" who say they understand when they do not.

(12) Fear ridicule or embarrassment.

E. Some trainees who lack understanding:

(1) Ask too many or too few questions.

(2) Have difficulty making the transition from symbols to practice.

(3) Fail to understand basic principles; consequently, cannot apply them to practical problems.

(4) Do not have the necessary background for learning in some courses.

(5) Do not understand the words used by the teacher because of a limited vocabulary or a foreign background.

(6) Have such good memories for facts that they do not learn principles.

(7) Discover, after casual study, that they have only partly learned the necessary material.

F. Some trainees who are emotionally unstable:

(1) Sometimes get excited so that they cannot do their best.

(2) Become angry or sulky if they are criticized.

(3) Become upset and weep if things go wrong.

G. Some trainees who live or study under poor conditions:

(1) Do not have a quiet place to work at home or in the depot.

(2) Do not have enough equipment or reference materials.

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QUESTIONS

(1) Using something that you have learned, go through the principles of learning to show how each one applies. As another example, go through the same process in connection with the learning of a trainee you have observed.

(2) What are the *messengers of the mind?*

(3) Which sense impressions are important in learning your specialty? How could you make use of them in your classes?

(4) Show how learning as a step-by-step process could be applied to something that will need to be learned by your trainees. What fasteners will help your trainees to learn more surely?

(5) What is likely to be most interesting about the work you are teaching? What additional interests might you build up among your trainees?

(6) In what way is developing a habit connected with learning by doing?

(7) What is a *habit?* Give an example, showing it in connection with the three rules for the development of good habits.

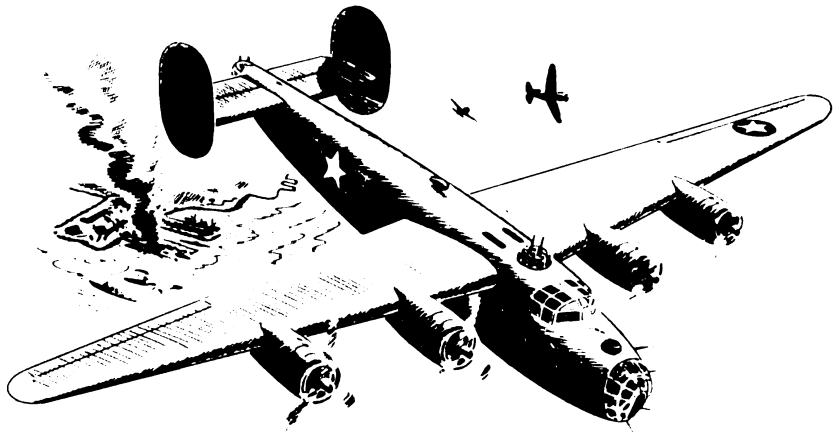
(8) What are the basic habits which must be learned by a trainee in your shop?

(9) How would you go about breaking a *bad habit?*

(10) Give the steps in the procedure for solving a *new problem.* Think of a shop or classroom problem which might be solved this way. Trace it through the suggested steps.

(11) Name four feelings that *help* learning. Give examples from your own experience.

(12) Name four feelings that *hinder* learning. Give examples from your own experience.



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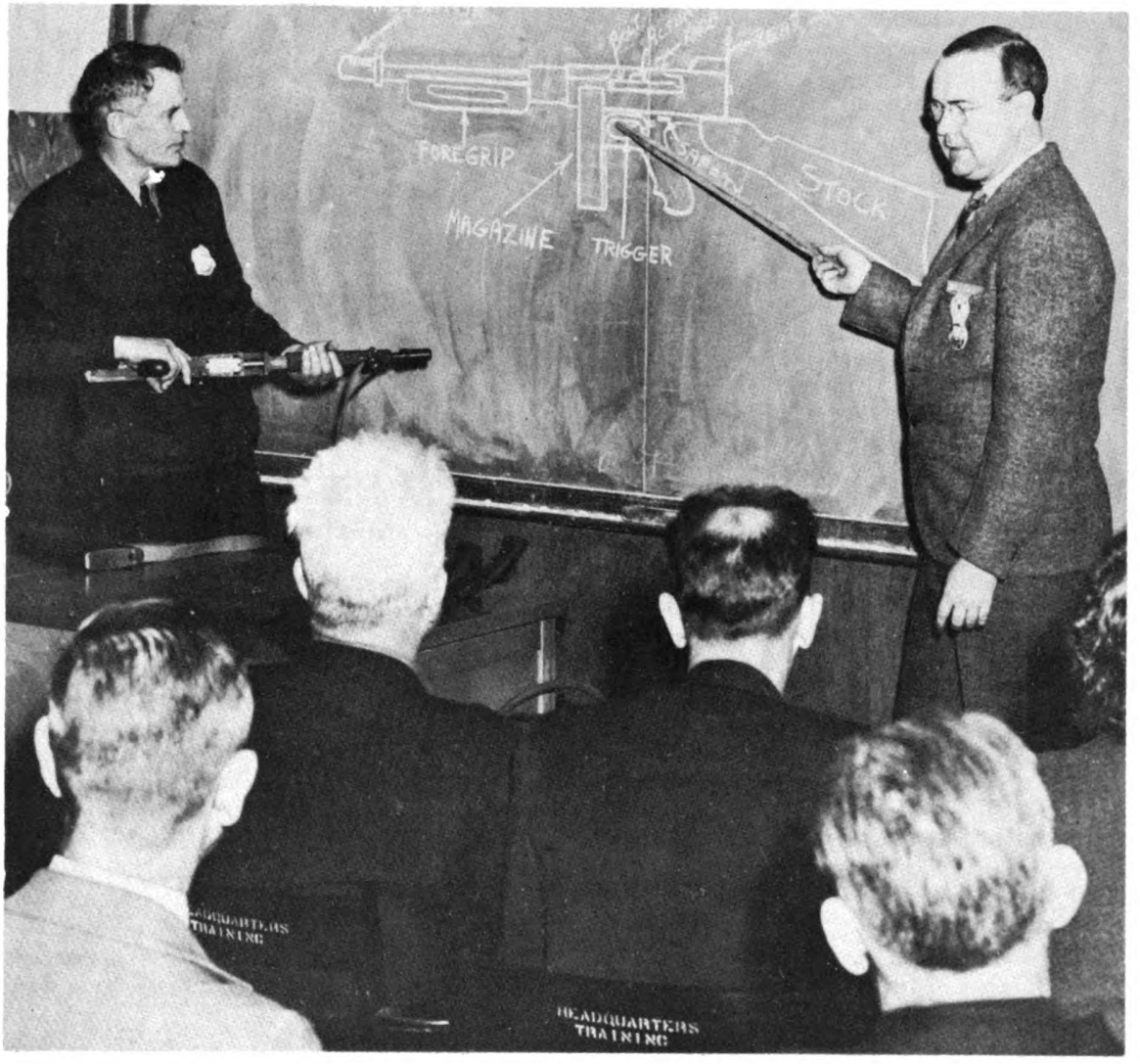
Chapter 3

HOW TO TEACH



The instructor looks at the various methods and techniques used in teaching.

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Figure 18—Informal teaching

HOW TO TEACH

You have probably done more teaching than you remember. You have been teaching every time you have shown anyone how to row a boat, ride a bicycle, repair a car, play cards, hit a golf ball, solve a puzzle, throw a ball, light a firecracker, or carve a roast. In each case you had to tell the person how to do it, show him, perhaps do it yourself, and finally you watched him while he did it.

Now let us consider a particular case. Suppose you have taught someone to swim. If at the beginning he was disinterested, you got him into the water by telling him how much fun it was, perhaps by yelling to him while he was on shore, "Come on in, the water's fine!" He had to be sufficiently interested to get into a bathing suit before you could tell him how to swim. If he was skeptical about keeping afloat, you may have pointed out to him that a balloon filled with air stays on the surface of the water, and that his lungs act like the air in the balloon to keep him afloat. He probably knew that movement of his arms and legs would drive his body through the water. Without any thought of teaching processes, you said, "Watch me!", and you floated, then swam through the water. Then, perhaps with some support, your pupil tried to imitate you, and you encouraged and corrected his efforts.

Now, imagine that you had stayed on shore and that your friend was the only person in the water. You can see how difficult, or almost impossible, it would have been for you to show him how to swim in the water while you simply told him how to do it, or read instructions to him from a book. This situation seems absurd unless you remember the examination questions you have missed, or the materials you have spoiled while learning a new skill—all because some teacher thought it was enough to *tell* you what to do. Just telling you to do a thing was no assurance that you wanted to, that you understood, or that you were able to do the thing.

In contrast, you can remember with pleasure the teacher who first aroused your enthusiasm about learning something. He simply and carefully explained what it was or how it was to be done. He demonstrated the skill or illustrated the fact, and then allowed you to take a hand in doing the thing while he listened and watched what you said or did. He helped you when you made a mistake, by pointing out what you had forgotten or failed to observe during his demonstration. He permitted you to try again; he checked your completed work and explained in detail the merits and errors of your statements or of your work.

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I. HOW IS IT DONE?

A simple way of describing how to instruct trainees is to say that we *tell* them, we *show* them, and then we *have them do it.* But telling is not teaching, and showing is not teaching. Real instruction requires you to take four important steps: **warm-up** by telling and showing, **presentation** by telling and showing, **application** by doing, and **checking** to find out if the trainee has learned. If he has not learned, the instructor has not taught.

If you can picture your job of instructing as being similar to the job of the coach of a football team, you can see how the idea of telling, showing, doing, and checking works. Suppose the coach is training you for blocking in an offensive type of play. He will tell you how to block, how to place your feet, your arms, and your head; then he will take your place in the line and show you how it should be done. After that he will expect you to do it; and if you do not do it correctly, he will check your performance and explain your mistakes. In the air depots, this coach-and-trainee type of training will give the best results. Since this method follows the pattern of all good instruction, let us make a careful study of the four steps of a lesson.

II. THE FOUR STEPS OF A LESSON

Most competent teachers follow the four basic steps described below.

To check the trainees' skill and knowledge; to determine the results of your teaching-learning situation.

To show trainees how to apply the new knowledge under your guidance.

To explain new ideas, skills, information, and procedure.

To arouse interest; to provide basis for information.

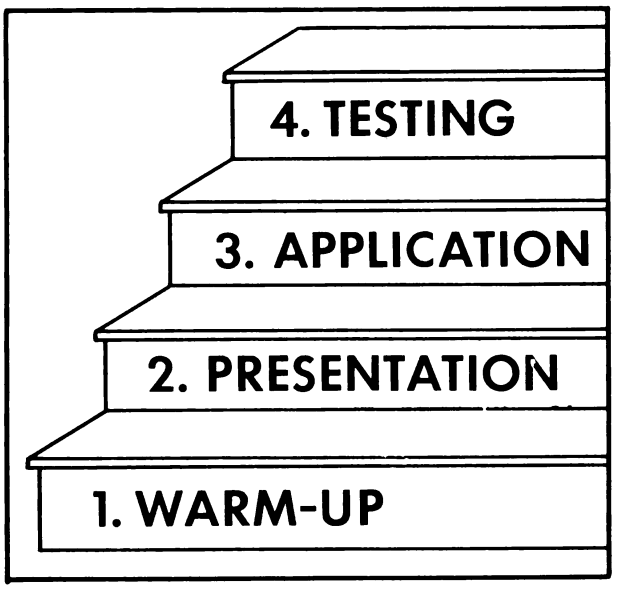

Figure 19—The steps of a lesson

Although these four steps are an obvious breakdown of most instruction, they are helpful particularly when considered in relation to the way we learn. The *warm-up period* should get the trainee *ready to learn.* He should be interested, and he should know the connection with previous learning before you go on to the next step. The second step, *presentation of material,* should build on his interest, on his previous knowledge. The new material should be given in the way best adapted to it. Usually one method is better than another for a certain purpose. For example, demonstration and drill are particularly good for teaching skills; conference is good for problem-solving among experienced men. The third step, *application,* gives the trainees a chance to apply their new knowledge by the actual and repeated use of the new material. Finally, at the end of the lesson, you *test* the trainee to find out how much he has learned. These four steps of a lesson must be planned carefully before each class if you want to use them effectively.

Let us consider these steps one by one. We assume that you know what is to be taught, and that you have the object of the lesson well in mind. You are now ready to take the first step in planning for your teaching period.

STEP 1. THE WARM-UP PERIOD

If your trainees had never seen a plane, it would be difficult to begin a lesson on engine or airframe repair. Fortunately, almost everything which you will be teaching is in some way connected with the experiences of your trainees. Finding these connections will prepare the trainees for the lesson in two ways:

(1) It should arouse their interest.

(2) It should remind them of knowledge on which the new learning of the lesson is to be based.

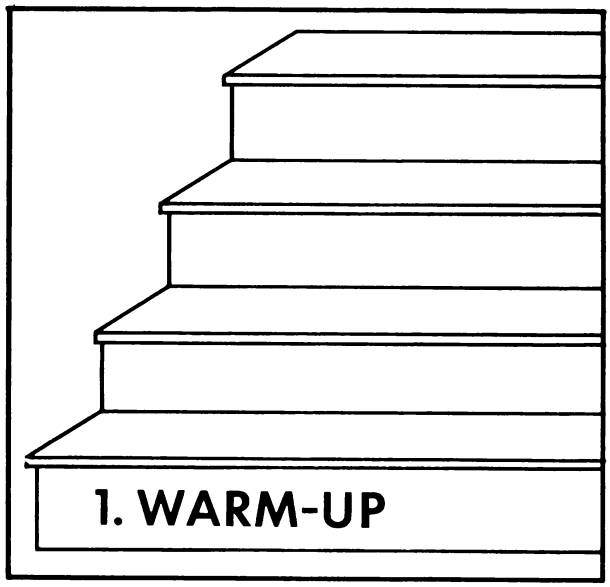

Figure 20—The warm-up step

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Keeping the new material definitely in mind, you look into their background for experiences connected with the new learning. There are two likely sources for these related experiences: their life outside the course, and their training within it. In the first, you may ask questions or remind them of some observation or bit of knowledge common to most persons. It may be drawn from their childhood, their school experiences, or their present life at home. It is a good idea to have several approaches at your command, so that you may shift to another if one fails to draw an interested response.

If you seek a base for your lesson within their experiences as trainees under your instruction, you will be fairly certain of similarity in background. Your course of instruction will probably be devised so that a skill learned in the first or second lesson is used in the completion of the fourth or fifth lesson. For instance, in training for aircraft riveting, in one of the first lessons the trainee learns how to drill a hole. In a later lesson, he uses this knowledge when he learns to drill out a defective rivet. You can see how a teacher might begin the later lesson by reminding him of his experiences in drilling earlier in the course.

You can also understand the need for arousing interest during this part of the lesson. The information on which the new lesson is to be based will be more vivid if your way of suggesting it arouses their interest. A routine remark about Lesson II, in which they were taught to drill holes would hardly arouse the trainees' enthusiasm for drilling out rivets. The basis of information, while called to their attention in this way, would not be of striking interest. If on the other hand, you showed them a defective rivet and asked them about its probable effect on the rudder of a bomber, they would be interested and concerned about the need for perfect work. You could then ask them how they would correct it, and help them to recall the lesson in drilling holes.

Remember that in the *warm-up period* you are not searching for ideas new to the trainees. Instead, you are trying to find knowledge common to all of them that will form a base for the new knowledge to be given in the lesson. No matter how elementary the lesson is, you must plan this part of it carefully. Do not skimp on this basic material, or the whole lesson may be a failure. Do not hurry through the first step. It may be desirable to have more material than you really need. After you have had some experience, you will know by the attitude of the trainees when you can go on to the second step. Until you are experienced, you had better lean toward too much, rather than too little, preparation.

STEP 2. PRESENTATION

If your plans are well made, your trainees are now interested and have a good base on which to tie the new information. You are ready for the next step. What is the best way to present material to trainees?

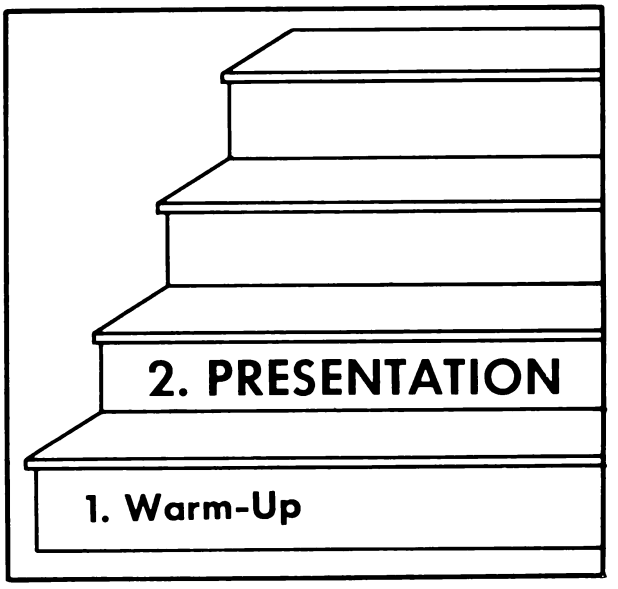

Figure 21—The presentation step

You have your choice of a number of commonly used methods. The best one for presenting a skill to beginning trainees is the *demonstration method.* In teaching a bit of information to advanced trainees, you can use the *illustration method.* You may use the *lecture method* by bringing all the trainees together to listen to a short talk which aims to stimulate general interest. Your methods depend in part on what the material is, and your objective in teaching it. If you aim too high and include too much, the trainees will be confused. For example, an instructor in Military Correspondence would confuse his trainees if he taught in one period the preparation and dispatch of confidential, secret, and restricted mail. The preparation and dispatch of confidential mail alone would provide enough material for the lesson. Besides the contents of the lesson, the choice of method may depend on the ability of the trainees. Some trainees will require less explanation than others because of individual differences, which will be discussed in the next chapter. Also, lack of equipment may prevent you from using the demonstration method, which is best under ordinary circumstances.

Your choice of method, then, is influenced in four ways:

(1) By the nature of the material to be taught.

(2) By the aim of the lesson.

(3) By the ability of the trainees.

(4) By the equipment you have.

At the same time, you need to consider several other aspects of the presentation of the new material. For one thing, you want to be sure to tell the facts or demonstrate the steps of the lesson in the proper order. In teaching the use of the electric drill, for instance, you should not show the students the switch and the actual drilling before you show them how to set the drill in the chuck. Further, do not drift into casual remarks

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unrelated to the step you are demonstrating. The complete attention of the students should be centered on the process they are watching. They should get a clear-cut picture of each separate part of the process, or of each division of the material. Careless thinking on your part is bound to be copied by your trainees.

Finally, you must emphasize the most important points by repeating them, by explaining why they are important, by using striking examples of their importance. For example, an instructor in aircraft painting and doping would emphasize that the gun used is level (not tilted up or down) in spraying dope on a plane, and should be held about eight inches from the fabric so that the dope will be applied evenly and in the right thickness. He would also undoubtedly emphasize safety precautions, since the dope is highly inflammable. In much shop work, ways of promoting safety in the use of machinery must be emphasized.

Later in the chapter, we shall examine more closely these and other common methods of presenting material to trainees.

STEP 3. APPLICATION

Now that you have aroused the trainee's interest and have shown him how to do something, he will want a chance to try it for himself. His effort to use the information you have just given him is called the *application* step of the lesson. You may ask him to explain the new material, or to do the thing himself. In any application, you still direct his activity, and correct and explain any mistakes he may make. It is very important that the trainees perform an operation the right way the first few times, for a bad habit is hard to correct. Operations which require skill should be done over and over again until they can be performed almost automatically by the trainee.

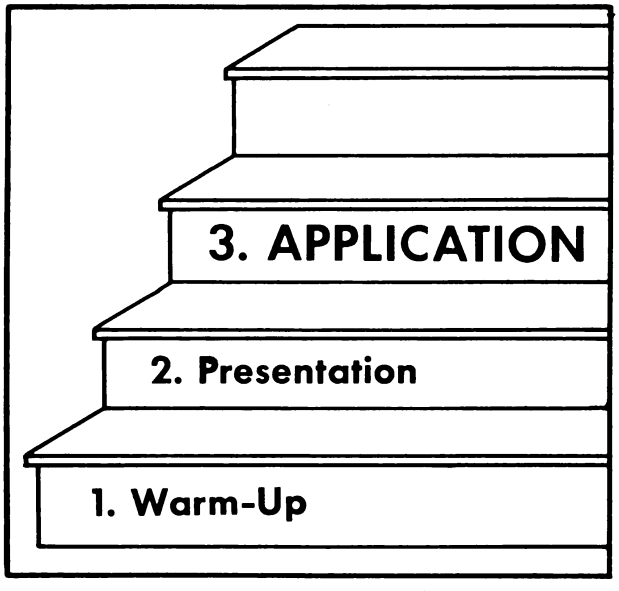

Figure 22—The application step

During the application step of the lesson, what would you expect to see in a shop or classroom? A trainee might be standing at the blackboard explaining the meaning of certain kinds of lines in a mechanical drawing; or he might be following the instructions on a job sheet as he worked with a drill press. In a typing class, a group of beginners may be learning how to use the shift lock by going through certain consecutive steps in unison. A class in Related Mathematics might be quietly working out problems similar to one the instructor had just explained. In each case, the instructional period has reached the application step in the lesson.

Although it is absolutely essential that the trainee actually do something with his new knowledge, you can sometimes combine the application with your demonstration. For example, if you have a fairly long and intricate process, you can do the hard step while the trainee does the simple steps. After he has mastered the easy parts, he can begin to do the others.

You may be surprised to discover occasionally that the trainees simply cannot apply what you have just presented to them. In such a situation, you must immediately stop them in their work and demonstrate or present the material again. Give them a chance to ask questions, and talk over their difficulties before starting them on the third step again. Actually, the four steps in the lesson do not always occur in one-two-three-four order. Sometimes, you will have to retrace your steps, particularly if interest lags. Ordinarily, neither you nor the trainees should be censured for such a variation. A typical lesson might go through the first two steps, then back to the warm-up, on to application, back to presentation, more application by the trainee, and finally testing. An alert instructor can sense from the attitude of the trainees whether they are ready to go on to the next step or not.

STEP 4. TESTING

When you are reasonably sure that the trainees understand the lesson, you can help them clinch their knowledge by *testing* it. In a test, they apply the knowledge or perform the operation without any supervision by you. You remember that in the application step, the trainees' work was constantly under your direction, they could ask questions, and their errors were prevented if possible. In a test, they are working *on their own responsibility*, so that you can find out exactly how much they know and what weak points need stress in additional training.

You will have your choice of many kinds of *tests*. You may ask questions in oral or written form, or you may ask the trainee to do a complete job on which he will be rated according to ASC standards. If you decide on a written test, you may use either the *objective type* or *essay questions*.

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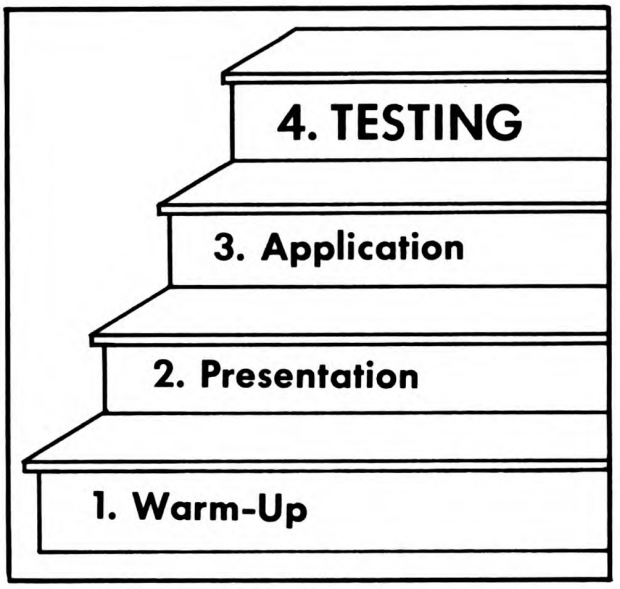


Figure 23—The testing step

You may actually conclude the lesson in a number of ways. Perhaps it will end with a test. On the other hand, you may think that a brief *summary* would emphasize the important points for them. This summary can be made interesting and forceful if you refer to the illustrations which you used in the presentation step. You may then want to tell the trainees something about what they are going to learn next, and how it ties in with what they have just learned. Challenge their interest in what is coming next. Give them a chance to ask questions about it if you have time. If you have an assignment for them, be sure that they understand what they are to do and how they should do it. Assignment sheets will save class time, since you need not repeat detailed directions to be found on the sheets.

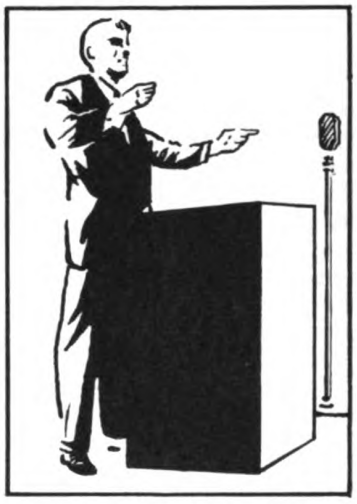
One of the tests of a good instructor is his ability to time the parts of a lesson so as to provide a good closing. Trainees are quick to sense the confusion if they must stop in the middle of an exercise or lecture, or if you shout last minute directions at them on their way out of the shop or classroom. When you have had enough experience so that you can round out the lesson adequately and at the proper moment say, "Class dismissed," you can feel proud of your achievement.

III. METHODS OF PRESENTATION

Although the discussion of teaching methods in the following pages is divided into Lecture, Demonstration, Illustration, Drill, Discussion, Conference, and Questioning, you will probably use two or three of them in every lesson. You have probably watched an instructor who lectured for five or ten minutes and then pointed to charts to illustrate. He may have stopped to ask questions before he demonstrated how to do the thing. Finally, he probably drilled the trainees in the new skill or knowledge. At other times, as in many typewriting classes, the entire lesson is drill work to fix the habits of the trainees. From your own experience, you can understand how one teaching method can be used for one lesson, or how several methods may be better for another lesson. Let us now consider each method separately. It will be up to you to put these methods together according to your needs in actual instruction.

A. THE LECTURE METHOD

Telling your trainees what you want them to know is a natural and necessary way of teaching. Every time you stop to explain something to a trainee at work, you are giving him a little talk which might be called an informal lecture if it were expanded and given to a larger group. When you comment on silent films which your trainees are watching, you are giving a lecture of a special kind. You will also find it necessary to talk to the trainees while you are demonstrating. Thus, you are using the *lecture method* whenever you talk to the trainees.



In combination with demonstration, illustration, drill, and discussion, the lecture method is valuable because the trainee *hears, sees,* and *does* something. By itself, the lecture is limited because the trainee only *hears* about something.

Though you may never give a formal lecture to your trainees, you can use the suggestions in this chapter for lectures or talks to improve your demonstrations, illustrations, drills, and discussions.

1. VALUE OF THE LECTURE METHOD.

If you use the lecture to supplement other methods, and if you talk in an interesting, lively manner, this method has several advantages:

a. You can arouse interest among the trainees for a new subject.

b. You can give them extra information, particularly material that is not available in any other form.

c. You can present much material in a short time to a large number of trainees.

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Figure 24—The lecture combined with demonstration and illustration

But hearing you talk about the material does not mean that the trainees have learned it. People usually need more than to be told if they are to learn.

2. DISADVANTAGES OF THE LECTURE METHOD.

a. If it is not used in connection with other methods—

(1) It may be hard for you to discover whether the trainees understand as you talk. They may not even be listening at all!

(2) When the trainees do not use the new information either by thinking, reciting, or doing, they are learning nothing.

b. If the lecture is carelessly prepared—

(1) You may waste time by rambling over poorly organized material.

(2) You may talk too long. Few of the trainees will listen carefully after twenty minutes.

c. DO NOT USE TALKS OR LECTURES.

(1) To teach material that trainees must grasp thoroughly and in detail.

(2) To teach a skill.

3. HOW TO USE THE LECTURE METHOD.

Though this method permits you to talk informally, it nevertheless requires careful preparation. You must not chatter on about anything that comes into your head during your explanation. On the other hand, you need not be stiff and formal. The best solution is to prepare your material so carefully that you can talk conversationally but pointedly. The best speaker aims to give well ordered points in a conversational, easy manner.

The steps in your preparation for a short talk are few, but they cannot be rushed.

a. Decide exactly what points need to be covered in this instruction period.

b. Look up the best material available on these points in books, manuals, technical orders.

c. Arrange your material in some clear order. For example, you can describe airplane engine models according to the type of engines, or you can give them according to the time of production, beginning with the most recent and going back, or beginning with earliest models and coming up to the present.

Be sure that the order of these divisions serves the purpose of the particular lesson, and that you keep them distinct by telling the trainees when you have finished discussing one and what you intend to explain in the next.

d. Jot down the points and the material that you intend to cover. A list or outline on a card or slip of paper is easy to glance at while you are talking. Do not write out whole sentences and paragraphs, or you will find yourself reading instead of talking to the trainees.

e. Run through the little talk several times so that you get used to it. If you omit an important explanation, make sure that you put a reminder of it in your outline. If you ramble on, time yourself for each rehearsal until you know exactly how much you can include. If you hesitate and have long silent stretches, you may need to know your material better and to practice aloud more frequently.

When someone talks to you from a platform or in conversation, you expect him to be direct and interesting. Your trainees expect you to speak well, and they will listen better when you do. ***Talk to them, look at them*** as you would in conversation. Start out with an interesting story or a startling fact. Tie each point to the trainee's experience; illustrate it with an example, or with some visual aids; watch their faces to find out when they understand. Then, go on to the next point. At the end, summarize. Allow time for them to ask you questions, and for you to ask them questions. This exchange of questions will cause them to listen more carefully and to learn more rapidly and surely.

B. THE DEMONSTRATION

In the ***demonstration lesson,*** the trainees are ***shown*** what you want them to learn as a result of the lesson. Usually, you show them how to do something with the tools, equipment, and materials that they will use on the job. You may demonstrate how to do a piece of work while you explain each step to the trainees. For example, you might operate a spray gun on the fabric surface of an airplane wing or rudder while your trainees watch you. As an instructor in guard duty, you might show the trainees how to hold, aim, and fire a pistol.

You will find the demonstration method has many advantages. First, demonstration aids learning by using at least two sorts of sense impressions, seeing and hearing. Since the trainee can *see* as well as *hear* about the skill or operation being correctly performed by you, his impressions are likely to be clear and more lasting. Moreover, all trainees regardless of age or ability can watch and usually understand a careful demonstration.

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Besides, a demonstration attracts their attention and usually holds their interest. By providing something for the beginner to imitate, the instructor proves that the thing can be done according to his directions. In other words, a good demonstration is convincing as well as stimulating.

Still other desirable features account for the frequent use of demonstration in the classroom or shop. It can be used with a group of reasonable size or in individual instruction. In combination with other methods of instruction—lecture, drill, discussion—demonstration adds clarity and interest.

Since information and skills usually are presented at the same time, the demonstration is an excellent method of getting the trainees ready to practice doing the skill, operation, or process being discussed. In this way, learning takes place when trainees are likely to be warmed-up and in good mental condition for learning.

1. WHEN TO USE DEMONSTRATION.

Demonstration will be useful to you in almost every period. You should use it whenever possible in the following situations:

a. To show a trainee how to do an operation, and how to develop skill in performance. For example, in showing a trainee how to tighten the joint of a tube with a fitting, you would actually use a wrench while he watched you. (See figure 25.)

b. To show a trainee how equipment and tools operate. For example, you could operate a valve reseating tool to recondition a valve seat in the cylinder barrel of an aircraft engine. (See figure 26.)

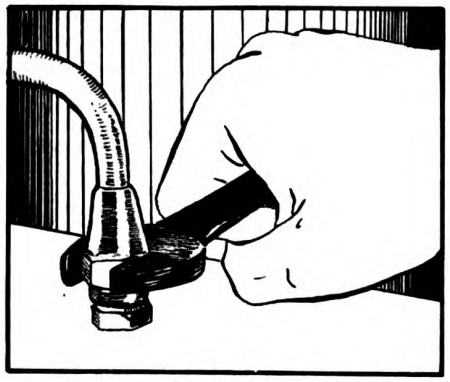

Figure 25—Demonstrating the tightening of a connection

Some of these demonstrations will take place in the classroom or shop where you can easily demonstrate for an individual trainee or for a group. Away from the job, you can demonstrate if you can move enough equipment from the shop.

In connection with other kinds of lessons, you can use demonstrations very effectively. Here are some suggestions:

(1) Trainees will understand a short lecture better if parts of the material can be demonstrated.

(2) Drill or practice work should be introduced by demonstration so that the trainees understand exactly what they are to do.

2. PLANNING THE DEMONSTRATION.

No matter how familiar you are with the demonstration, careful planning is important if the lesson is to be successful. As you might expect, your lesson plan will include the objective of the lesson; the purpose of the demonstration; a list of the necessary equipment, tools, and materials; an outline of the steps in the demonstration; and the important points to be emphasized.

Several rehearsals of the demonstration will help you do it more smoothly for the trainees. Here are some suggestions about these rehearsals:

a. Set up the necessary tools, equipment, and materials. Everything should be in readiness so that the demonstration need not be interrupted while you search for tools.

b. Time the demonstration. If it lasts more than fifteen or twenty minutes, better break it into smaller parts.

c. Arrange the equipment so that the light is good. There should be neither glare nor shadow.

d. Decide where the trainees will be. They should be able to see and hear easily during the demonstration.

3. WARM-UP FOR THE DEMONSTRATION.

At the beginning of the actual lesson, when your materials and equipment are in readiness, your first thought must be of the trainee. You will want to tell him the connection between this lesson and what he has learned before, and the usefulness or importance of learning this new operation or skill. To hold his

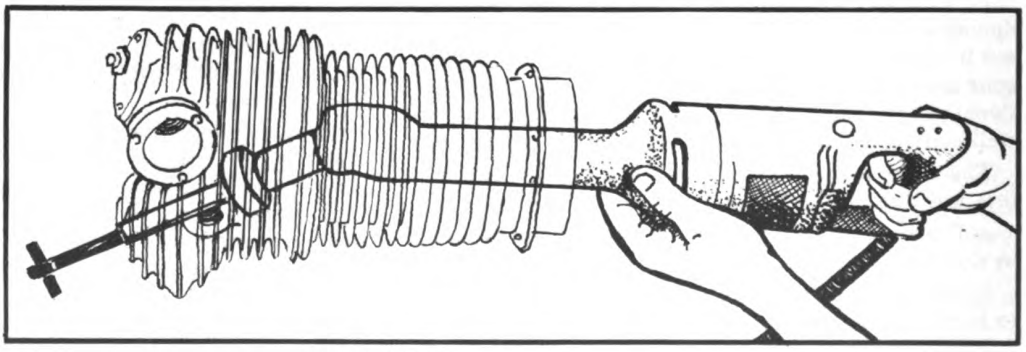

Figure 26—Demonstrating valve reseating

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attention throughout the demonstration, you tell him what points to watch most carefully. A list of questions will direct his attention to the important steps of the demonstration and provide an easy check-up afterward.

4. THE DEMONSTRATION ITSELF.

In this part of the lesson, you are likely to be telling the trainee about the operation at the same time that you are doing it. For that reason, careful planning about what points need explanation will prevent you from including aimless remarks that are not needed for a clear understanding of this operation. No matter how interesting such unrelated information may be, you should rigidly exclude it from your explanation lest your trainees be confused or distracted. Nevertheless, what you tell them should hold their interest. The best way to keep them alert is for you to speak clearly and enthusiastically.

When the trainees are ready for the presentation, you can group them around the table or machine or blackboard so that they all can see and hear the steps of the demonstration. If there is any danger, they should be a safe distance from the machinery. Now state the purpose of the demonstration and explain its process. For example, you could say:

"Here are the parts of an aircraft B.G. spark plug. In a moment, I am going to show you how to treat the parts with anti-rust oil, and later how to assemble them. We have 1000 spark plugs like this one on hand. This morning we received an order to treat them with anti-rust oil and to have them assembled and ready for shipment as soon as possible."

For the actual demonstration, you may find the following suggestions helpful:

a. If the trainees are not experienced in any of the parts of the demonstration, you should go through the complete process at normal speed. This sort of demonstration gives them an understanding of the whole and insures their continued attention.

Then repeat the demonstration slowly, explaining each step so clearly that the trainee gets a full and vivid impression.

It is a good idea to finish by going through the process at normal speed with any necessary explanations.

b. If the trainees are experienced with some of the operations, you can ask one or more of them to do the familiar part of the process. This will give one or more trainees additional practice and hold their interest. In the meantime, you can ask rapid fire questions to keep the other trainees alert.

c. If the trainees are to develop proper habits or skills in a short time, you must follow the accepted methods in your demonstration. Their first imitation should be done correctly.

You may ask one of the trainees to record on the blackboard the important steps in the order of their occurrence during the demonstration.

d. Emphasize any safety precautions at the time of demonstrating a step or operation that contains an element of danger.

e. Ask questions during the demonstration to guide learning and keep attention fixed on the process.

Encourage the trainees to ask questions as you repeat the demonstration.

f. Summarize the important steps in the process, and emphasize the key points in each.

Figure 27—The trainee applies what he has learned

5. APPLICATION OR TRY-OUT BY THE TRAINEES.

Immediately after your demonstration, ask the trainees to go through the process you have just shown them. Provide them with materials like those you used, and if possible, like those used in a real job of production.

Pay particular attention to the trainees who find the work difficult. If you notice one of them making a mistake, call his attention to it and show him the correct way. Otherwise, he may get into the habit of doing the operation in the wrong way. For example, a trainee who holds a file incorrectly should be shown the proper way immediately. Or, when a trainee fails to grasp one of the steps, that part of the process must be demonstrated to him again. If several of the trainees are uncertain about a few steps in the process, you can call

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them together and demonstrate again. You can sometimes find out how well they have learned by asking questions.

One good way of encouraging trainees of superior skill is to ask them to demonstrate if the less competent ones need a repeated demonstration. They can also help the slower trainees to learn correctly. While the skillful trainee is helping or demonstrating, make sure that he is going through the process correctly.

6. TESTING AND FOLLOW-UP OF DEMONSTRATION.

Although you will find detailed recommendations for testing in a later chapter, you will probably check up on the trainee's learning by finding out after the demonstration whether he can perform the operation successfully, by asking him questions to see if he understands it. Finally, the trainee should have an assignment which will provide practice by requiring him to repeat the operation.

C. THE USE OF ILLUSTRATION

1. IF YOU CANNOT DEMONSTRATE, ILLUSTRATE.

If you do not have the equipment, machines, or tools for a demonstration, you can substitute visual aids, such as charts, blackboard sketches, and films. In connection with an interesting talk, this illustrative material will give the trainees some understanding, though it will not teach them skills. As a substitute, it is best suited to advanced trainees who have some background and experience in the course. For example, advanced trainees might learn the names of the parts or operations of an automatic pilot if the equipment itself was unavailable, or unhandy to move. You would tell them about the automatic pilot, and you could show them a model with cut-away sections showing the parts and construction.

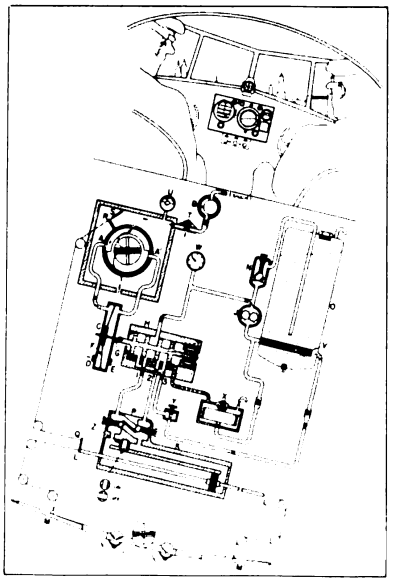

Figure 28—Illustration—the automatic pilot

In addition, you could use blackboard diagrams, charts, and film strips to make the parts or operations of the automatic pilot clear. (Figure 28.)

If materials or essential equipment are very scarce, you can still make your lesson interesting and vivid. For example, in instructing trainees about the operating principles of a gun turret, you may use training films, film strips, charts, or diagrams instead of the actual gun turret.

2. SELECT YOUR ILLUSTRATIVE MATERIAL WITH CARE.

Be sure that you have some way of showing each item you want to teach. Perhaps one picture, mock-up, cut-away, or diagram will illustrate only part of your lesson. Do not stretch such material to include other points you wish to make; instead, find good material that will aptly illustrate the other points. For example, a model of an engine would not show the flow of gas from fuel pump to injector carburetor; but if you added a blackboard diagram, the illustrative material for your lesson would be complete and clear.

It is also a good idea to illustrate one point in as many ways as possible. Some trainees most easily understand pictures; others catch the idea from charts or diagrams. It is better to make one item clear with a number of illustrations than to limit yourself to one sort of illustration for many points.

3. SHOW YOUR ILLUSTRATIONS ONLY AT THE TIME YOU USE THEM IN THE LESSON.

Keep your charts, pictures, or diagrams covered or reversed until you are ready to use the material. Keep the blackboard clear or covered until you are ready to emphasize a particular point by writing or drawing on it. After the trainees have copied or used the drawings, diagrams, or outlines on the blackboard, erase them so that they will not attract the trainees' attention when you are dealing with some other material.

KEEP IN MIND THAT THE ONLY PURPOSE OF ILLUSTRATING IS TO EMPHASIZE OR MAKE CLEAR THE POINTS OF YOUR INSTRUCTION. The use of illustrations is further developed in Chapter 9.

D. PRACTICE OR DRILL LESSON

In the *practice* or *drill lesson*, the trainee learns by exercising a skill under your direction. Each trainee gets his instruction and tries it out at once, while you guide and correct his efforts. He then repeats the process thoughtfully until he can do it quickly and well.

Lives may depend on the successful use of the practice method. For example, a parachute rigger must learn his job by actually packing real chutes. Over and over he goes through the process until he does it correctly (figure 29).

In such a situation, the trainee is learning by doing. Practice is at its best when the trainees use real materials, real machines, and production methods. Then, the trainees should be tested by production standards.

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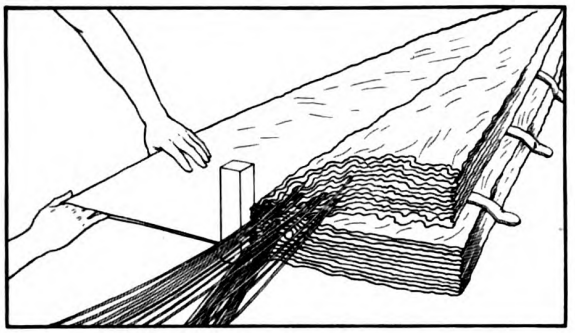

Figure 29—Practice lesson in folding a parachute

Because they are producing a real job that can be used, they are likely to work hard and learn rapidly. There is no better way to arouse interest. Another advantage is that the trainee's workmanship can be seen. You can watch him while he is doing the job, and you can examine the finished product.

Another form of this lesson uses drill on essential information. Any job at the depot requires some knowledge that the trainee uses as often as the average civilian uses his ability to read or to make change. For example, work on propeller repair requires that all trainees in this field know the particular parts of a certain propeller. This requires drill. Also, the instructor in sheet metal work would use the drill method for teaching recognition of stringers (figure 30).

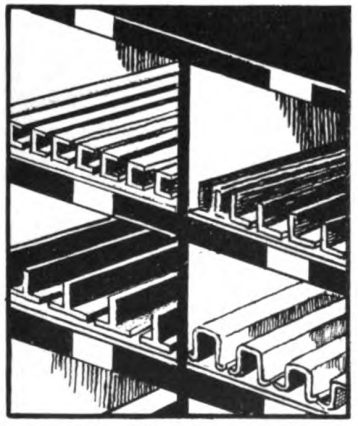

Figure 30—Stringers

1. WHEN TO USE PRACTICE OR DRILL.

You may select the practice method when you want the trainees to learn to do a job quickly in a certain way. If they need to learn a skill to the point where it becomes a habit, they must carefully repeat the operation until they master it. Usually, the trainees practice in order to learn some skill with their hands. For instance, a simple operation like filing the jagged edge of a piece of metal takes much thoughtful practice before a trainee automatically holds and uses his file correctly.

You may use the drill method to help the trainees remember essential information. Some facts should be as thoroughly at their command as the multiplication tables, which everyone learns by the drill method. A stenographer, for example, should know the ordinary forms of military correspondence without looking them up for every letter or memorandum. Only by drill can she learn these forms. Her instructor must see that she has a chance to use these forms over and over in class work.

Actually, when a skill or an essential piece of information must be thoroughly mastered, you have no choice of method. In these cases, the only possible way for a trainee to learn thoroughly the skill or essential information is by practicing or drilling.

2. HOW TO USE PRACTICE OR DRILL.

Throughout the practice or drill lesson, you should keep in mind two important facts about learning. First, the trainees will learn the new skill or information better if it is tied with old skills or experience. Second, their habits can best be formed if you follow these simple rules:

a. Get the trainees started doing the thing right.

b. See to it that they do it always in the same way.

c. Encourage them to think about it while they do it.

d. Have them do it over and over, at regular and frequent intervals.

To get the trainees ready for a practice or drill lesson, you should arouse their interest, and help them see the connection between what they are going to learn and what they already know. In the first few minutes of a typing class about to practice tabulation, the instructor could remind the trainees of their use of the space bar to count out spaces between columns. They would then understand the purpose of the tabulation mechanism, and they would also be interested in learning how to use it.

In the next step, you must show the trainees clearly what they are to do or know. In the typing class you should show how to operate the tabulator. If you are teaching trainees how to install brushes on a generator, you should demonstrate the steps of the entire process before asking them to practice it. On the other hand, if you are teaching a depot supply worker, you should list and explain the symbols for various types of equipment and material. If he knows and understands exactly what he is expected to learn, he will drill on it with more interest, and he will learn it better.

The trainees are now ready for their actual practice or drill. *If the trainee is to practice a skill,* you have many responsibilities. Here are a few suggestions:

a. If possible, see that the trainee has the kind of materials and machines that he will find on the job.

b. Watch the trainee carefully while he does the job. See that he starts correctly. Try to prevent him from making mistakes. If he does make a mistake, immediately correct him in a quiet and patient way. Do not hurry him or make him nervous by your supervision.

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Figure 31—Correcting mistakes

c. Give him suggestions about the *best* way to do the job. Tell him why it is the best way. Point out short cuts.

d. Encourage the trainee to ask questions. Ask him thought-provoking questions that will require him to think for himself.

e. After the trainee has finished the job successfully, have him repeat it until he forms the habit of doing it perfectly, easily, and rapidly. Be sure he understands why he must do it over and over. If his persistent practice is to be effective, you must be sure he is interested and attentive rather than bored with the monotonous repetition. For this purpose, you can encourage him to be satisfied with nothing less than perfection; you can vary the jobs slightly to avoid monotony; and you can arrange for rest periods to help him avoid fatigue.

f. Let the trainee know how the quality and quantity of his work compares with that of the other trainees. He should be aware of his progress.

Finally, you must test the success of his practice. The only test is whether or not the trainee can do the job well. Can he met the aviation standards for the job? For example, can he pack a parachute properly in a reasonable amount of time?

On the other hand, *drilling the trainee on essential information* requires more devices for keeping him interested. Here are a few of the symbols or subclassifications that depot supply workers must learn by drill:

01 Airplanes and Spare Parts
02 Engines and Spare Parts
03 Aircraft Accessories
04 Aircraft Hardware and Rubber Materials
05 Aircraft Instruments and Laboratory Test Equipment
06 Fuels and Lubricants
07 Dopes, Paints, and Related Materials
08 Electrical Equipment and Supplies
10 Photographic Equipment and Supplies

You can imagine how dull it would be for the trainees if you set them to work memorizing this list. Besides, learning the symbols in this order might cause difficulty when they tried to recall one particular symbol in the middle of the list. When you try to remember what letter precedes "F" in the alphabet, you probably start at the beginning. Such a procedure is the wasteful result of learning the alphabet only in the order of its letters. Now how could you drill these trainees on the symbols in depot supply so they can recognize or use any separate symbol instantly? Here are some useful variations in drill procedure:

a. Make up a list of the symbols in an order different from the one above. Ask the trainees to fill in the meanings of each symbol by finding the answer in the text or on the blackboard. Later, when they are more familiar with the list, they can do it from memory.

b. Make up a list of the materials in an order different from the one in the text. Ask the trainees to fill in the symbol for each one. At first, permit them to use the book. Later ask them to do it from memory.

c. After the trainees know the symbols fairly well, list the symbols on the board. Conduct a rapid drill by pointing to a symbol and calling one trainee by name for the answer. If the trainees know the list well, point to the symbols in no regular order so that each trainee must recognize the symbol immediately as you call on him. For variation, you can list the materials, and ask the trainee to tell you the symbols. You may also let a trainee give the answers until he makes a mistake; then call on another to continue.

d. At the end of intensive drill, you may give a short written test arranged according to symbols or materials.

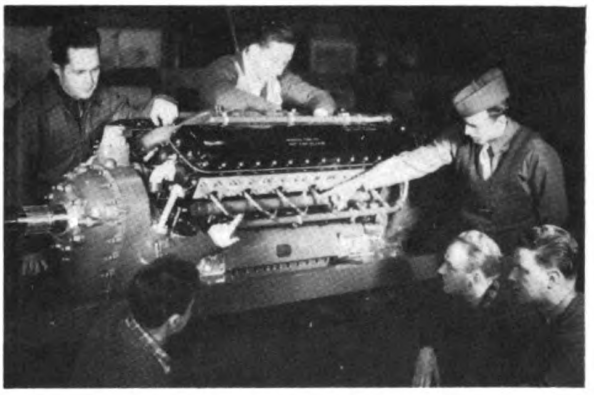

Figure 32—A discussion in the shop

E. DISCUSSION

Discussion is an orderly form of conversation between the instructor and trainees. It consists of questions and comment from the instructor combined with answers, comments, and, occasionally, questions from the trainees. Planning for a discussion in class may be geared to an experienced or inexperienced group.

Discussion method for an inexperienced group:

Discussion is one of the best ways to arouse the interest of the trainees in their work. In a good discussion, everyone helps by saying what he thinks about at least

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one of the topics. He then takes a personal interest in the progress of the discussion, and this interest tends to carry over into any work which follows. Besides, such discussion often helps the trainees to get acquainted with each other and with the instructor. The instructor can also find out special interests and differences of the trainees. All of this is likely to result in a good classroom spirit that will promote learning.

1. WHEN TO USE DISCUSSION.

a. In the warm-up period, the instructor may introduce new material through discussion. You may ask questions to establish a base for new learning within the experience of the trainees. If you asked a beginning class in electrical wiring about their experiences with lamps, extension cords, and electric switches at home, they would be able later to tie the new technical knowledge to their everyday experiences. They would also be curious to find out the answers to the questions that they did not know. In this way, you can arouse interest and establish a teaching base at the same time.

b. After a lecture, shop exercise, or film, you may start a discussion to make sure that the trainees understand your explanation, their work, or the material in the film. Trainees are more alert if they know they will be asked later to discuss what they have seen or done or heard.

c. At the end of a class, you may use discussion as a means of summarizing the lesson. Giving the trainees this responsibility makes them more attentive, and often speeds up their learning.

2. HOW TO USE DISCUSSION.

To start the discussion, direct the attention and interest of the trainees toward the topic. You may introduce the discussion by telling an experience of your own or of someone else, by raising a question that has come up in the class before this time, or by asking an interesting question directly concerned with the topic. Another way of approach is through the use of the blackboard. You may simply write the topic on the blackboard or draw a diagram showing the problem.

Keeping the discussion going requires the interest and help of all the trainees. Your questions should be good ones, framed according to the suggestions given in the section on questioning. You can help the trainees to talk freely by being natural, good-natured, and sympathetic. A timid trainee can be encouraged to talk by asking him if he agrees with something that has been said, or by asking him questions that you are sure he can answer. The quick thinker, on the other hand, must be prevented from talking too much. You can give him extra responsibility for special reports or for keeping all the trainees sharing in the discussion.

You must stay on your topic in order to keep the discussion going. If you plan your discussion carefully and know exactly what topics are included in it, you can detect instantly any comment which is outside the subject of the lesson. You may say tactfully that an interesting question has been raised, but that it will have to be discussed at another time. Also, frequent summaries keep the trainees so aware of the progress and direction of the discussion that they are not tempted to take a side track.

At the end of the discussion, you can ask a series of short questions to make sure that the trainees understand what has been discussed. Then you or one of your able trainees should summarize briefly. Trainees should not leave the class feeling that they had merely engaged in talk. A summary will help them to see the discussion as a whole and to feel that progress has been made.

Figure 33—A conference

F. CONFERENCE

Conference method for an experienced group:

The *conference* is a form of discussion based upon a problem experienced first-hand by all the trainees. A lesson developed by the *conference method* should encourage experienced trainees to think about their problems, to state the facts about them clearly, and finally to decide what should be done about them. At the end of the conference, the trainees should reach an agreement about the best solution for their problem.

Properly used, the *conference method* has many advantages. The trainees can speak freely and feel that they are giving valuable information to the group. The instructor is a guide, not a boss; and the lesson becomes informal and democratic in nature. Under these favorable circumstances, the trainees learn to analyze jobs and situations, to use good judgment, to co-operate with others in pooling experience and in reaching a conclusion. In other words, the conference method is a democratic way of instructing trainees to think efficiently and to work together harmoniously.

1. WHEN TO USE A CONFERENCE.

The *conference method* is suitable for only a few situations in the work of an air depot. To make sure that you plan to use it appropriately, check the situation with these tests:

a. Your trainees should have experienced the same problem or problems, and

b. Some of them, at least, should have tried to solve the problem.

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Unless these two conditions are met, the conference will result in time-wasting chatter. Remember that a conference draws upon the experience of the trainees for its material. A group of foremen or supervisors will profit greatly by pooling their knowledge and experiences about the problems in the shop. Without such experience, the trainees would have nothing to contribute and they might be disinterested. Do NOT use the conference method—

a. When the trainees are inexperienced.

b. When you want to introduce information new to them.

The conference of a group of inexperienced trainees about to start a new subject is useless, for it results only in pooled ignorance.

2. HOW TO USE A CONFERENCE.

In this as in all other lessons, your preparation before the session is very important. Even though the trainees provide most of the information, you must know the problems that will probably be brought up, the questions you will need to use, and the points that will need emphasis. It is also important that you arrange for the comfortable seating of the trainees around a table in a quiet and well-lighted room.

You can open a conference by using any of the methods suggested for starting a discussion. Your opening of the conference should be clear-cut but not dictatorial. For instance, you could say "Mr. Adams has been telling me about one of his problems concerning safety in the shop. Perhaps some of you have a similar problem in this connection. I suggest that we talk these problems over and see what can be done about them. Suppose you start us off with your problem, Mr. Adams."

After the conference is under way, it is your business to keep it going. The trainees' thought should be directed constantly to the purpose of the conference, and the comments should make steady progress. Once again, the devices for keeping discussion going are useful for the conference. As a conference leader, however, you must keep the channels of conversation clear. A good way to do it is to help mold the comments by the trainees into a clear pattern. This pattern should not be forced, but should come out naturally. Here are some of the most useful patterns for conferences. Often you may want to put them on the blackboard as headings.

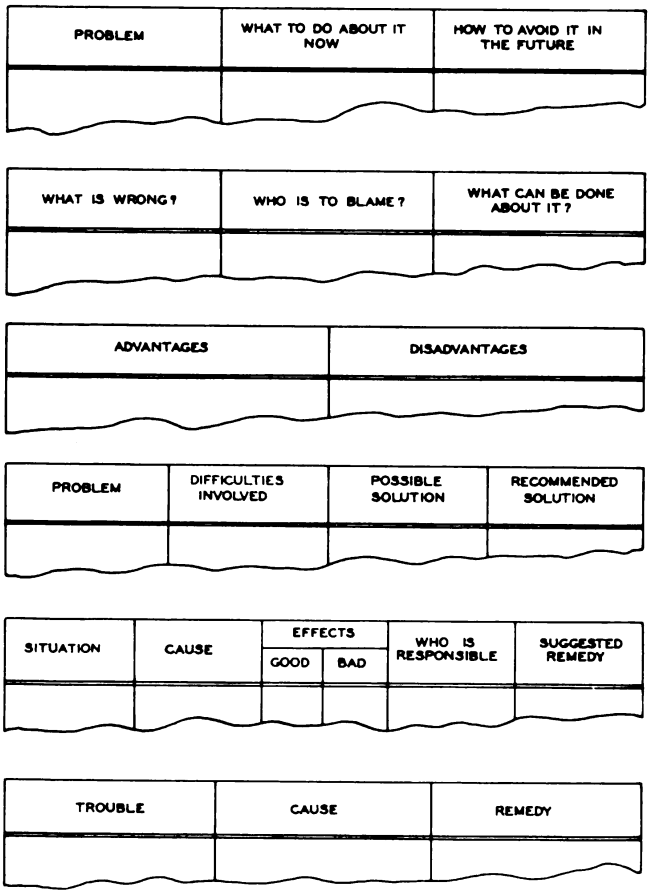

Figure 34—
Conference patterns

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In spite of a good start and careful plans, a conference session sometimes runs into trouble. You may suddenly be aware that your group has lost interest. They may show disinterest by being silent, or by talking about other topics. If you are sure that the subject has a real appeal to them because of their experience, you may secure their interest in several ways. You may ask them to apply the general theories to their own job. Or, you may give them a specific case and ask them how they would handle it in the light of the material already discussed. If possible, you may introduce a chart or pictorial material to rouse their interest.

At other times, the conference may suddenly swerve to dangerous topics and heated arguments. In either case, the best remedy is to recognize the danger signals and steer around the trouble by questions or comments on a related but safe subject. Personal criticism aimed at members of the group or at the officers and training staff of the depot is one example of a dangerous topic. By ignoring bitter criticism, or by appealing to their sense of fair play, you can often save the situation. Criticism of policies and of situations that cannot be changed should usually be avoided. Occasionally, you can use such criticism as a challenge to work out the best possible way of dealing with a difficult situation.

Sometimes an apparently harmless argument grows heated and threatens to become ill-tempered. A good way to handle this problem is to ask the group to suggest the merits of each side while you write them on the blackboard. During this process, the leaders in the argument usually become quiet.

As a last resort for either a dangerous topic or heated argument, you may summarize the discussion up to that point and give the group a new question to consider.

Most important of all in any part of a conference, you must be able to ask questions that are clear, interteresting, and vitally concerned with the subject at the moment. In a later chapter you will discover how to ask good questions.

Finally, a conference like any other discussion must be completed by a summary. You may ask the trainees to suggest summary statements or concluding points of agreement. While listening, you can sense when these suggestions have the approval of the group. Then, write them on the blackboard. In this way, you emphasize both the co-operative nature of the conference and the points that have been made.

G. QUESTIONING

People say it is easy to ask questions—but is it? Certainly any child can ask questions that stump the experts. But when an expert asks good questions of learners, he must neither give the answer away nor obscure it entirely. In other words, the question must be neither too hard nor too easy.

In comparison with your trainees, you are an expert. Again and again you will find need of asking them questions for various purposes.

1. PURPOSES OF QUESTIONS.

a. To get attention, your question may provoke curiosity about a new subject. You might ask, "Why is it important that machine guns be installed correctly in the wings?", or "What would happen if they were installed incorrectly?". If you are using a question to recall the attention of a day-dreaming trainee, you may ask him to summarize the points you have just made, or to tell the class the steps in the operation you have described. Actually, you can snap him into attention by asking a question on almost anything that fits the instruction at that point: he could be asked for facts learned before that pertain to the lesson at the moment; he could be asked to think about and judge a method just discussed; or he could be asked to summarize what has just been said or done.

b. To find out whether trainees understand, questions are absolutely necessary. But those questions must require definite and complete answers. For example, you might ask, "What are the steps in installing oxygen equipment in a plane?", and "Why should you always follow this procedure?". This type of question requires the trainee to summarize and explain what he has learned or what he is to do.

c. To help the trainees recall facts, questions should require short answers given without delay. The trainee's memory should supply him with the information quickly. Here are some examples: What type of engine is used in the P-63? How many gallons of gasoline do the wing tanks of the B-17E hold? How many copies of a communication should be with the original when it reaches the addressee? What does the property classification O6 mean in depot supply?

d. To guide the thought of the trainees, a carefully planned sequence of questions is necessary. For this purpose, the trainee must be given more time to think about his answers. His response may require thought about what he has just seen or done, or it may require him to figure out causes, effects, or influences. For instance, the key question of such a sequence might be, "Why is shielding necessary for all wires in the ignition system of a plane?". If the trainees cannot answer the key question, you may use a comparison with an auto-

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mobile and then break it down in this way: What would happen to the automobile radio if suppressors were not used? What is shielding? How is it like a suppressor? Then, why is shielding used on the ignition system of a plane? Although the trainees may figure out the answer from any one of the follow-up questions, you must be prepared to go through all of them if necessary.

2. HOW TO CONSTRUCT GOOD QUESTIONS.

A five-year-old child can surprise and weary adults with endless questioning; but as he grows older, his questions become more exact. An instructor, too, soon learns how to ask definite questions that cannot be misunderstood. Here are some hints from experienced instructors who have learned how to ask good questions:

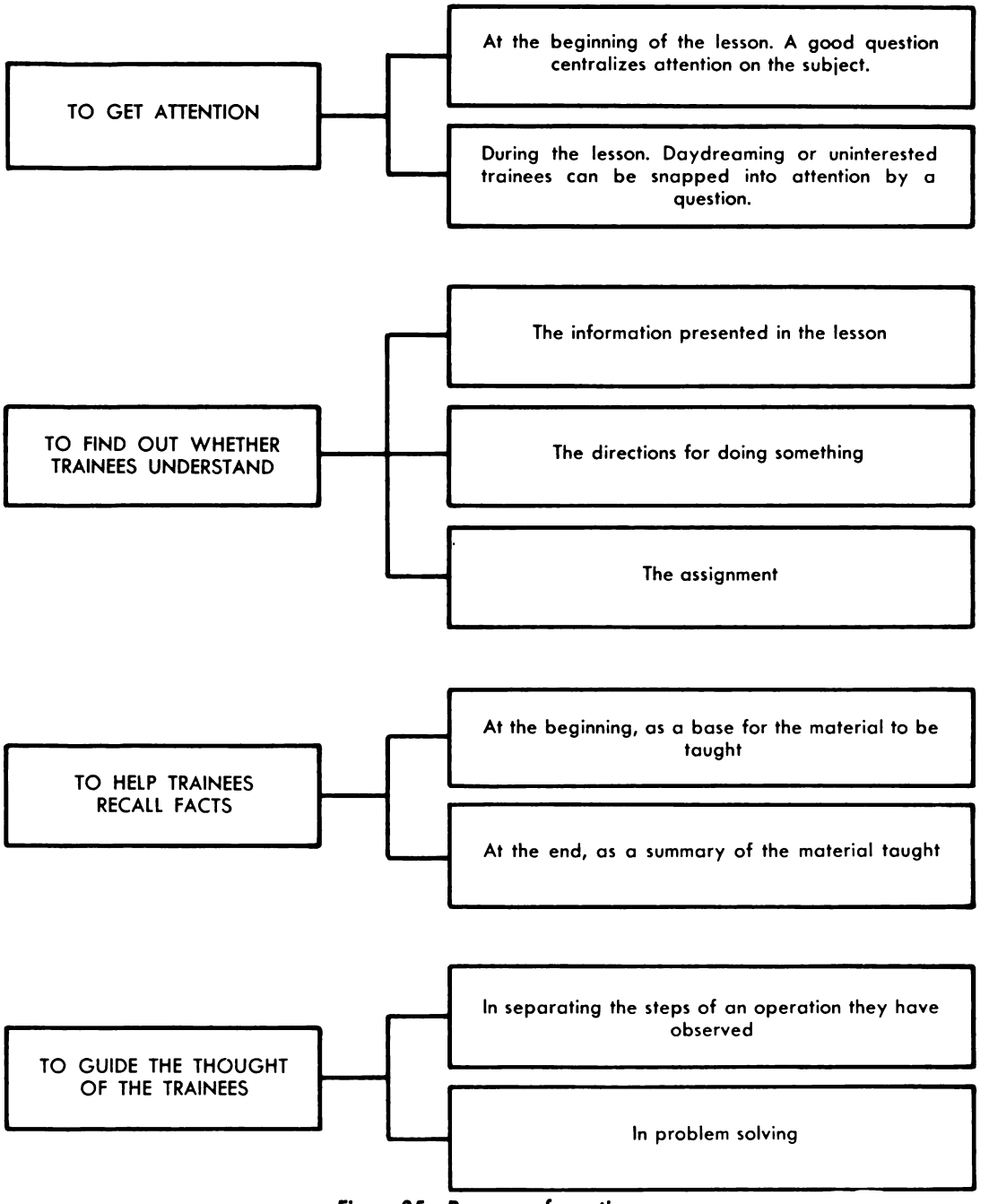

Figure 35—Purposes of questions

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a. Limit each question to one main thought.

Thinking a moment before you ask a question will help you to see clearly the one idea you want to bring out. Avoid asking several questions in one breath or linking several questions together with "and"; for example, avoid "What is a gyropilot for, and how does it work, and how do you know when it is out of order?". Substitute and sharpen up the wording of any part of a rambling question like that before using it.

b. Word your question carefully.

If trainees frequently misunderstand you, or if you find yourself saying "What I mean is" at the beginning of a restated question, you are receiving signals that your questions are not clear.

Here is a check list to help you discover the reason your questions are not clear:

(1) *Do you know exactly what answer you expect?* Vagueness on this point is always reflected in the wording of the question. For example, if you want trainees to know the difference between an air-cooled engine and a liquid-cooled engine, you should ask them specifically "What is the difference, etc.?", *not* "What do you think about the air-cooled engine?".

(2) *Are you using terms that the trainees do not understand?* You cannot assume that the trainees are familiar with all the technical terms you know, nor that their vocabulary includes all the big words you know. If it is necessary to use a word unfamiliar to the trainees, define it carefully when you first use it, and then use it in connection with another word meaning about the same thing until you are sure they understand instantly. For example, the first time you use the term "butterfly valve," you could describe it as being like a damper in a stove pipe. Then, if you discuss the use of the butterfly valve as a throttle valve, you could refer to it as the butterfly or throttle valve. Later, when you refer to the choke valve, you could explain that the choke valve is a butterfly valve used to cut off the air supply to the engine. Thus the trainee will become familiar with all similar technical terms before he is puzzled by their use in questions.

(3) *Do your questions ever have two or more possible meanings?* If your trainees give you unexpected answers, the chances are that your questions are poorly worded. For example, the question, "Why do officers salute each other?", might be answered with any of the following:

(a) To show respect.

(b) They are carrying out a custom started when knights lifted their visors to show that they met in peace rather than for battle.

(c) Because they have to.

(d) Because they fear reprimand for refusing.

(e) They do not have to if they are of equal rank.

The number of answers could probably have been reduced to one by using the following wording: "Why do present regulations require a junior officer to salute a senior officer?"

(4) *Are you using the words in the text so often in framing your questions that the trainees depend on their memory?* To avoid this parrot-like response, apply the material to examples not included in the text. Then from the trainees' answers, you can make sure that they understand the principle or information.

(5) *Are you using "catch" or "trick" questions?* If you ask why safety wire is used on gyro rotor, when it is never used there, you are tricking the trainees. This practice robs you of your trainees' confidence, and all of your questions are likely to seem confusing to them.

c. Keep your questions in good form.

Here are some suggestions about the general structure of questions that are useful to experienced teachers:

(1) *The question should be a complete sentence.* If you ask a fragment of a question, such as "Any explanation possible?", you are encouraging sloppy thinking and expression. The trainees will tend to answer questions carelessly if you ask them carelessly. In addition, a trainee who does not remember that you are talking about the failure of a landing gear cannot pick up the thread of the discussion from your question.

(2) *The question should not give itself away or be too easy to answer.* Usually a question should require the trainees to think out the answer. For that reason questions requiring "Yes" or "No" for an answer are often undesirable unless they are followed with a trainee's explanation of why he selected his answer. The actual structure of a question can sometimes give away the answer. For example, "You wouldn't use red identification tape to indicate a water line on a plane, would you?" gives the answer away immediately. A trainee's answer to a good question should tell you whether he really knows the material or not.

3. HOW TO ASK QUESTIONS.

a. The steps in questioning.

Good instructors have found several distinct steps in questioning. The asking of each question falls into a pattern which you can begin to use immediately:

(1) State the question to the entire class.

(2) Pause for a moment while all trainees think about the answer.

(3) Call the name of one trainee for the answer. (If you call on him first, all the rest may lose interest.)

b. Your manner of questioning.

During the questioning, you can see to it that the atmosphere is informal, but that the trainees are alert and well-behaved. If your manner is easy, confident, kindly, and interested, the trainees will be encouraged to do their best thinking. Here are some other points to remember:

(1) Speak *clearly,* and loud enough that everyone may hear. Do not shout.

(2) Do not repeat the question for a trainee who has not been paying attention. If it is necessary for the inattentive trainee to answer the question, ask another trainee to repeat it.

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(3) Do not allow all the trainees to answer at once. The group would become noisy, and you could not check any trainee's grasp of the information. For the same reasons, do not permit prompting. An answer whispered to a trainee is likely to confuse him.

(4) Praise any trainee who thinks out an answer admirably. If it is an excellent answer, you may say, "That is a good answer," or "That shows good thinking." Sometimes you might ask him how he figured it out, so that the other trainees might learn from him. But any earnest trainee should receive some praise for his effort, even though the result is less than brilliant. Find the good *part* of his answer, and encourage him for having thought it out, or for having expressed it well.

4. GIVE EVERYONE A CHANCE TO ANSWER QUESTIONS.

Every trainee in the room should feel that he must be ready to answer each question. In order to encourage this healthy attitude, each trainee must actually be asked a question at least once or oftener in the period. You can assure yourself that you are distributing the questions fairly if you follow these suggestions:

a. Do not make a practice of calling on the bright trainees only. True, you will receive correct answers quickly from them; but the other trainees may not understand the material, and they may become discouraged.

b. Do not call on trainees by an alphabetical list or seating chart. They soon figure out their turn and may be inattentive during the rest of the period.

c. Call on trainees in all parts of the room. Do not neglect the back row or the front row, or the other trainees who do not volunteer.

d. Avoid a two-way conversation with one trainee. Otherwise, you may be led into asking him a series of questions, or explaining unimportant points to him alone.

e. Make a point of asking questions of an inattentive or unruly trainee. It secures his attention and prevents him from distracting others.

In addition, the questions you ask the trainee should suit his ability. It would be useless to ask a bright trainee to answer an easy question, or to ask a slow-thinking trainee for a complicated answer. Each should receive a question that demands his best thought, but one that he can answer.

5. THE TRAINEE ANSWERS.

Your instructing will be better and easier if you require good answers from your trainees right at the beginning. Do not let them get into the habit of mumbling their answers, or of giving haphazard fragments and letting you fill in the gaps. It is a great temptation for an instructor to accept an inexact answer in the rush to get on with the lesson. But it is foolish, for the material must often be repeated anyway.

Further, the trainees should be encouraged to use acceptable English in expressing their answers. One of the best ways to set a high standard for the trainees is to use your best English when you are with them. Then they will admire and try to imitate you when they have a chance to talk to you.

6. THE TRAINEE ASKS QUESTIONS.

Encourage your trainees to ask thoughtful questions. In this way you can uncover and correct anything that they do not know or that they misunderstand. Good questions from trainees indicate that they are alert, interested, thoughtful, and that your instruction is really going across to them.

Not even a beginning instructor should fear a question which he cannot answer. No one expects any one person to know everything, anyway. As long as you do not bluff, you need not be embarrassed about an answer you do not know. In response you should admit frankly that you do not know. Then you can promise to bring back the answer as soon as you find it. Or, if you know exactly where it may be found, you may ask the trainee (probably the one who asked the question) to look up the answer and report it back to the class. In any case, see to it that the answer is brought back. You would be unwise to dodge the answer completely unless it has no importance in the course you are teaching.

QUESTIONS

(1) Explain the purpose of each of the four lesson steps.

(2) Give an example of two different approaches which you might use in the warm-up step for a lesson in your specialty.

(3) Suggest a plan for presenting the lesson which you have discussed in question 2.

(4) Suggest three different ways in which trainees could apply the material for a single lesson you might need to teach.

(5) Give four suggestions which would be helpful in preparing for a demonstration.

(6) When should you use *illustration* as a method of presentation?

(7) Give two suggestions for making illustration more effective.

(8) In what situations might you use a *short discussion* in class?

(9) Describe a *drill lesson* which you might use for instructing trainees.

(10) In what situation might you use the *conference method?* Name four patterns that a conference might follow.

(11) Give examples of good questions in connection with some particular unit you will probably teach.

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Chapter 4

INDIVIDUAL DIFFERENCES

The instructor recognizes individual differences that should be taken into account in teaching.

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INDIVIDUAL DIFFERENCES

Headlines of special achievements flashed in every paper help us to recognize the *individual differences* of people. The timesaving invention of the man on the assembly line brings to mind also the time waster; the success of a great musician may help you to recall the hours you spent at the piano before you decided to study something else; the long knock-out record of a boxer could easily make you feel your jaw in retrospect as you visualized your own dashed hopes of such a career; the story of superhuman endurance of our front line fighters may recall visions of others who "gave up."

Within your own experience, too, are incidents which show the differences of your acquaintances. We can all recall the basketball player who rarely missed a basket, but most of us charitably forget the player who seldom made a basket; the unusual grace and poise of the professional skater make the clumsy gyrations of the amateur fade into the background; the boy who could ride his bicycle standing upright with both feet on the saddle could be contrasted with the poor soul who could never learn to ride even in the conventional manner; the star halfback of the football team would outrun and outguess most of the other players. You, too, have a different personality from others and, no doubt, have been outstanding in one way or another; for instance, you evidently have some special qualities which will enable you to be a good teacher.

We account for the unusual ability of persons by saying that they have been trained in a most thorough and efficient manner, or that they have inherited certain physical characteristics of the nervous system, the muscles, the glands, and other organs of the body, which make their performance better than that of the ordinary person.

Another way of accounting for individual achievement is in terms of mental ability. You can remember that some of your classmates were bright, some were dull, but most of them were average. The differences in mental ability are as great as in physical strength and skill.

The term "individual differences" could be applied to all of the differences between individuals. These would include all physical, mental, moral, religious, emotional, and other differences. As an instructor, however, you are concerned only with those differences in individuals which affect their rates of learning.

The most important individual differences connected with learning are differences in education and work experience, mental differences, and emotional differences.

I. TYPES OF INDIVIDUAL DIFFERENCES

Let us consider for a moment these differences as you will find them among your trainees. Finding out about emotional differences among your trainees is difficult and time-consuming, but you can expect the same range of emotional reactions that you find in your own family, in your own social group, and in your own city. People tend to *feel* strongly about certain things, and to show their emotional reactions. If you decide that your group is made up of a faultfinder, a bully, a sensitive person, and several fairly normal and well-adjusted persons, you have recognized the individual emotional differences in that group. Your ability to recognize these emotional types, however, has resulted from familiarity with a faultfinder in your own household or in your neighbor's family, from past experience with a bully, a sensitive individual, and some ordinary persons.

One great source of difference is likely to be found in the trainees' work experience. The trainees under your direct supervision may be recruited from many walks of life. Many of them may know little or nothing of machines, manufacturing processes, or office procedures. A few of them will have a knowledge of mechanics, which they have picked up by working on an automobile, a sewing machine, a bicycle, or a lawn mower. Perhaps one or two of them will have considerable knowledge of mechanics or office procedures because of previous work with industrial concerns or in business offices.

Your trainees' educational background may vary even more than their work experience. You may have trainees who have trouble in reading the questions of an examination with understanding, or in writing clear answers to the questions. You may also have trainees who find difficulty in speaking, reading, and understanding the English language. You can help them considerably by using many pictures, charts, and models in your class instruction. When you work with them individually or in small groups, you may go over written material sentence by sentence and ask them the meaning of key words. Above all, do not scold them for their language difficulty nor evade your responsibility by telling them that they will just have to work harder.

Some may be experts in a specialized field not related to aircraft. For instance, after years of training for the concert and opera stage, a girl with a fine singing voice recently learned riveting. In short, your trainees may vary in educational background from those who just finished grade school to those who are college graduates.

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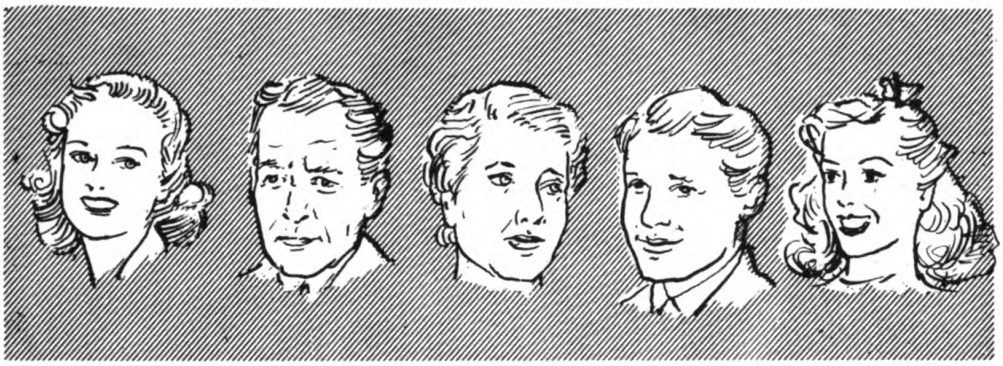

Figure 36—Individuals differ

Among the members of your group will be some slow learners and some who learn very rapidly, but most of them will learn at an average rate. The swift learners will understand quickly and finish their work promptly. Others will need several explanations and more time in which to grasp the information or learn a skill. If you can find out the educational background and work experience of each trainee, you have clues to his probable speed in the mastery of his work. In order to get this information, it is a good idea to have each of your trainees fill out a blank, similar to the Personal Data Sheet given below.

A careful study of these sheets after they have been completed by the trainees may suggest their differences in background and interest. But how can you provide for these differences in class or shop work?

TRAINEE DATA SHEET

Name_____ Date_____
Street Address_____ Phone_____
City and State_____ Sex_____
Marital Status: Married_____ Divorced_____ Single_____ Widowed_____
Date of Birth_____ Age at last Birthday_____
Number of Dependents_____

EDUCATION

Grammar School High School
Circle highest grade completed: 1 2 3 4 5 6 7 8 9 10 11 12
Did you graduate?_____ What school?_____
Chief subjects studied_____

College or University
Name of school attended_____
Date attended_____ Circle number of years completed: 1 2 3 4 5
Chief subjects studied_____

Other School
Name of school attended_____
Date attended_____ Course taken_____

PHYSICAL CHARACTERISTICS

Weight_____ Height_____ Vision_____ Capable of_____ (Heavy) _____ (Moderate) _____ (Light) work

EXPERIENCE

Type of Work	Machines Used	Number of Months of Employment

Type of work you prefer:_____
Remarks: (Hobbies involving any mechanical skill)_____

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II. HOW CAN YOU PROVIDE FOR INDIVIDUAL DIFFERENCES?

The easiest way of providing for individual differences is to instruct only one trainee at a time. In such individual instruction, only the instructor and one trainee take part. Because of the easy informality of this situation, the trainee can be encouraged to explain any of his doubts or misunderstandings to the instructor as soon as they come to his mind. Consequently, he learns the skills or information as fast as his training and mental and physical ability will permit. Besides, the instructor can then select and adapt the job best suited to the learning speed and ability of the trainee.

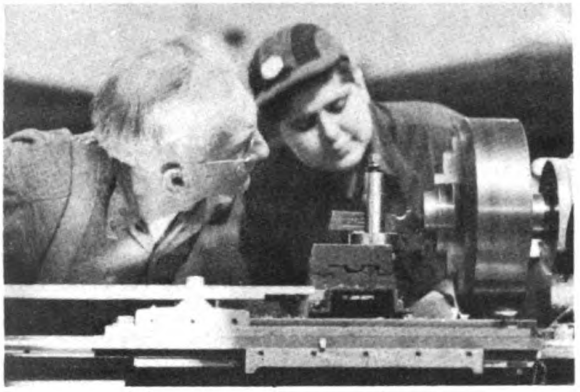

Figure 37—Individual instruction

On the other hand, you may be asked to instruct a large number of trainees at one time. You would expect them to vary in interest, ability, and emotional stability. How could you arouse the interest of trainees whose natural interests are varied? How can you prevent those who are physically or mentally slow from becoming discouraged? Is it wise to suggest that the slow learner shift to a class in which he can learn another skill? Are you justified in making such a suggestion on the basis of a short trial? To these questions involving individual differences, you will be expected to provide reasonable answers. In the following examples, you will find suggestions about dealing with some typical situations.

III. DIFFERENCES IN INTEREST

Suppose you are given a class of 25 persons who are learning to typewrite. One of the first things you may discover about this class is the *variety of their interests.* Some of the trainees may be eager to become expert typists; others may be willing and conscientious but not thrilled at the prospect. A few may have no interest in typewriting at all. Perhaps they have been advised to enter the class because there are no openings for other kinds of workers. Among these disinterested trainees, you may find a woman who has had experience in teaching school, another who has been a clerk in a store, others who have been beauty parlor operators, librarians, or elevator operators.

Figure 38—Individual differences in a typing class

How can you make your instruction appeal to such a group of persons whose interest may be intense or weak? What common ground can you find among those whose natural interests vary?

Fortunately, you can base your appeal on some interests which are characteristic of almost all persons. For example, the spirit of competition often promotes the interest of trainees in a typing class. Since it is likely that their abilities will differ, you are safe in urging them into competition in speed, accuracy, and accomplishment of extra assignments. You can promote this competition by posting charts on which you can record each trainee's name, his top speed in tests, the number of perfect copies he makes, and the number of assignments he completes. Under this system, even the slow trainees sometimes make a fairly good showing if they are willing to practice longer than the others.

Another way of interesting most trainees is to show them how useful their new learning will be to them. In school or in business, skill in typewriting is an asset. Trainees will also be interested to know that the amount of skill they attain is likely to depend on the effort and practice they are willing to devote to it.

IV. DIFFERENCES IN ABILITY

At the same time that you arouse the interest of the trainees, you are faced with the challenging opportunity to provide for their *variations in ability.* No matter what your trainees are learning, some will need more practice than others. You can make that extra practice interesting by giving a variety of drills. In typing, for example, the constant use of the same drill to strengthen certain fingers may become unbearable to the trainees. Changes in the routine, such as rhythmic typing to a phonograph record, or a different series of words or letters, add to their interest in the work.

The following suggestions will be useful in providing for differences in the rate of learning among trainees:

(1) For the slow trainee, avoid monotony by providing many different situations involving the same principle or the same operation.

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(2) For assignments to the trainees who work faster than the average in the group, prepare an abundance of related instructional material, such as reference texts, job sheets, operation sheets, information sheets, graphs, charts, etc.

(3) Often the same job is more difficult to do with one piece of equipment than with another. To the trainee with greater ability, assign the more difficult equipment or the more difficult job.

(4) Make long lists of possible jobs in keeping with your objectives. From these lists, choose those jobs which will appeal to the trainee's interests and which are in keeping with his background.

(5) Use the better trainees of the group as leaders to aid in training the others who learn more slowly.

There are other ways of providing for individual differences in ability. Some instructors assume that all trainees can understand a procedure if they learn a rule. Others realize the need for explanation and demonstration. Suppose an instructor of arithmetic told her class to memorize the rule for long division and then work ten problems in long division by following its instructions. Some of the trainees might be able to do this assignment; others who did not know the meaning of "annex the next figure of the dividend to the remainder" might have trouble.

Another instructor of this subject might ask the following question: "If your yearly salary were $1560 per year, how much would you earn per month?" All trainees would probably be interested in the problem; some would immediately know that the problem should be solved by division. The instructor might then refer them to the rule in the book, and demonstrate its use in dividing 1560 by 12 on the blackboard. The next step might very well be to ask the trainees to find out the monthly salary if the yearly salary were $2500. This method would take into account the average trainees without boring the more brilliant ones. For the slow ones, the instructor might have to go over the process more than once.

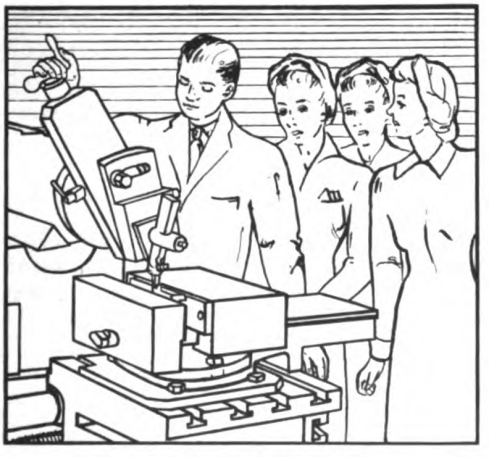

Figure 39—Group instruction

Although you may use all of the best techniques in providing for individual differences, a perfect solution of the problem is difficult. For instance, if you assign extra work to the bright trainee, he may feel that he is being penalized for his progress. On the other hand, the slower learner may resent spending the extra time necessary for him to keep up with the others in the group.

In the instruction of small groups also, you can provide for some individual differences in ability. Group instruction is given by the instructor to a small group of trainees who are ready for certain information at the same time. This group usually consists of from two to six trainees. For example, in a machine shop where most of your teaching is usually done with individuals, several of the trainees may be ready to begin work on a shaper at the same time. In that situation, you can call them together and conduct the lesson for those particular trainees rather than present the material separately to each individual.

While these trainees observe, you can set up a job in the shaper and demonstrate how to do it. You will want to give the demonstration slowly and carefully, explaining each step while doing it. After the demonstration, you will naturally give the trainees a chance to ask questions, and you should answer their questions carefully.

If you notice that some of your trainees have learned less rapidly than others you can say, "Let me go through the operation of the shaper once more in order to be sure that everyone understands each step." You can then repeat your demonstration and again answer all the questions of your trainee group.

V. DIFFERENCES IN EMOTIONAL REACTIONS

After you become acquainted with your trainees, you sense their *emotional responses* to you and the work. A good instructor learns to watch for signs of anger or pleasure or fear which may vary with the individual. Certainly it is true that a casual remark might frighten one trainee, anger another, and arouse the interest of a third. In classwork, then, it is important to promote good feelings among the greatest number of trainees.

In your dealings with individuals, however, you can adapt your comments to their particular temperaments. For instance, you will want to be consistently gentle with a sensitive person, though you may be stern with a bully or a chronic faultfinder.

In general, trainees must be kept reasonably happy if they are to make swift progress. Of course, you cannot untangle distressing home conditions, nor make really difficult work seem extremely easy. But you can lighten a trainee's emotional problems by understanding them, and by helping him solve them. You can also add zest to very difficult work by admitting that it is hard, and by being interested in the progress of your trainees. Such an attitude on your part will actually arouse pleasurable emotions among the trainees as they master their difficult jobs.

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Anyone who receives deserved praise on the job or in school learns more rapidly than if he is always reminded of his mistakes. You probably remember with great pleasure the teacher or employer who praised you when your work was well done. Similarly, you can encourage your trainees by commending a perfect paper, a well-set rivet, a neat job of safety wiring, or a well-tuned engine. Praise for good work is one of the best and easiest ways to provoke pleasant emotional responses among all trainees.

VI. SPECIAL PROBLEMS THAT HAMPER ARRANGEMENTS FOR INDIVIDUAL DIFFERENCES

Unusually large classes or lack of equipment make it difficult to provide for individual differences among trainees. If you are faced with the double problem of large classes and inadequate equipment, you will need to lay your plans very carefully lest your trainees develop bad attitudes toward you and their work.

The simplest way of avoiding large classes is to change the schedule so that more classes are offered. In this way, some of your trainees may be sent into another class in which the same type of training is offered. On the other hand, if your class is large because the trainees have not been carefully classified, some of them might be transferred to another type of training for which they are qualified.

When you must instruct a large class with inadequate equipment, you can solve some of your problems by carefully planning the work of the trainees. For example, if you have a class of thirty trainees but only fifteen lathes in your shop, you cannot teach all of them to do the same thing at the same time; but when they learn to cut a shaft to a smaller diameter, you can stagger the work on the lathes. In carrying out this plan, you introduce the new work and then have all the trainees study the operation sheet which explains the procedure on the lathe. You then divide the class into two groups, and send one group to a classroom under the direction of one of the more able trainees, who distributes examination questions dealing with the problem they have just studied on the operation sheet. While the trainees in the first group are answering these questions, you show the others how to do the job in the shop, and then help each one get started on a simple job of turning. At the next meeting of the class, reverse the procedure. The trainees who have written the examination should be given a chance to apply their knowledge in the shop. The trainees who have studied the operation sheet and have worked on the lathes should be given a harder written test to make sure that they have thoroughly understood the skill. Varying the difficulty of the examinations makes this makeshift arrangement more nearly fair for all trainees. It is also wise to alternate the groups so that the group which takes the first examination in one unit of work will be given the second examination in another unit of work. Trainees are quick to appreciate your effort to be fair with them under difficult conditions.

Staggering the shop work helps you to give more individual instruction because fewer trainees are at work in the shop at the same time. If the range of individual differences is great, you must still plan to spend all of your time in the shop going from one trainee to the next, explaining what each one needs to know at the moment. This may mean finding extra work for a trainee who has studied engineering, and at the next machine explaining the functions of the parts of the lathe to an ex-housewife. The slow and inexperienced trainee may be held to certain minimum requirements which will call for extra work on his own time. The more able trainee may be assigned special reports or special work; or, he may be asked to help the slow trainees to master their work.

The problem of too little equipment can often be solved by improvising. For aircraft test equipment, such as ammeters, voltmeters, vacuum pumps, and fuel pumps which are difficult to obtain, you might use modified instruments from automobiles. If you are resourceful, you can adapt easily available equipment to suit your needs. But you must study the material carefully and adapt it accurately if it is to help your trainees learn. They must also understand that it is improvised equipment, and that it differs in certain specific ways from the equipment that you should have for the instruction.

QUESTIONS

(1) Give three explanations for the unusual achievements of outstanding individuals.

(2) Describe the individual differences you are likely to find in training classes at an air depot.

(3) What are *individual differences?* Which ones are most important to an instructor?

(4) What important differences among your trainees could you discover by careful study of trainee data sheets?

(5) How does the size of the class affect your effort to provide for individual differences?

(6) In the subject you expect to teach, how could you provide for:

a. Differences in interest?

b. Differences in ability?

(7) At what points in learning might you expect trainees in your subject to become discouraged? How would you keep this emotional reaction from having a bad effect on their work?

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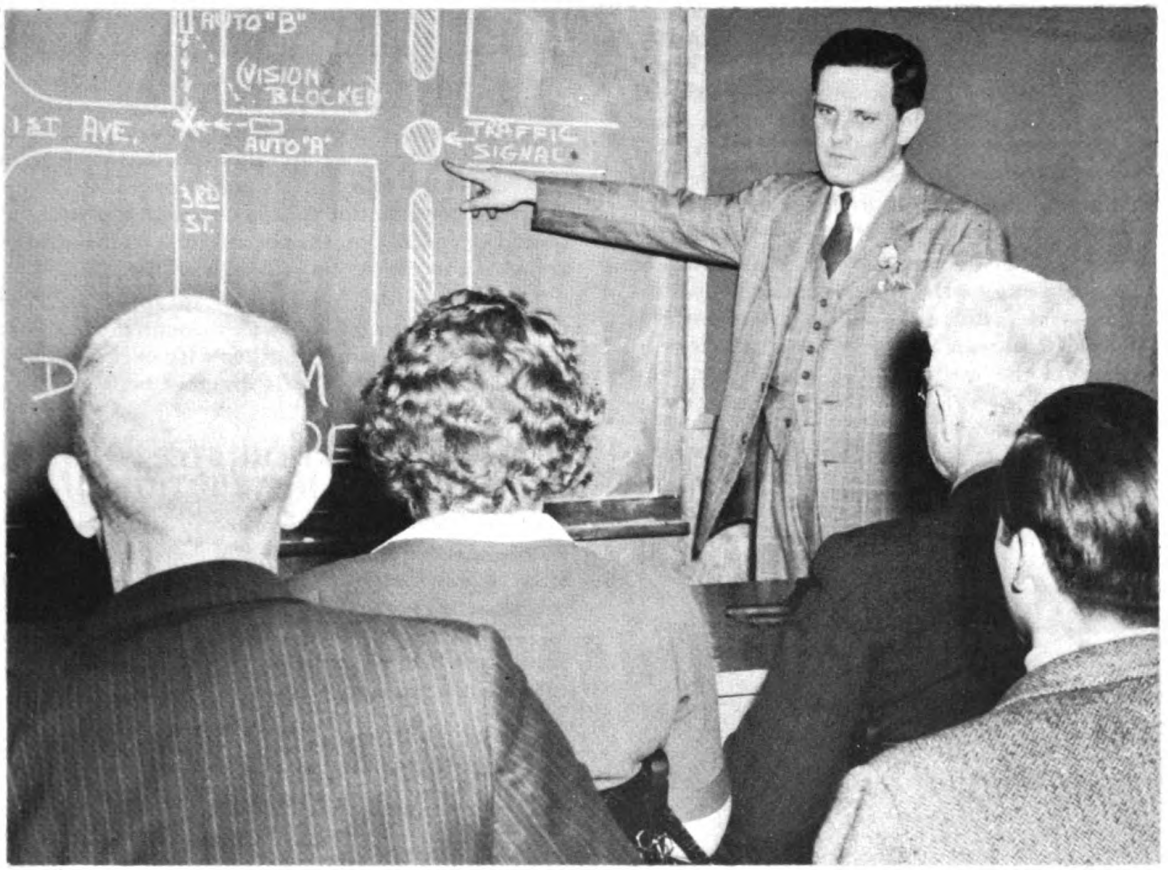
Chapter 5

INSTRUCTING INDIVIDUALS AND GROUPS



The instructor compares individual and group training, and observes instructors in action.

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INSTRUCTING INDIVIDUALS AND GROUPS

Whether you are dealing with individuals or groups, your only concern is to help them learn. Your job is to see that they acquire skill or knowledge so that they can be competent workers in the air depot. You use the same fundamental principles in teaching and learning for the individual trainee that you use for a class of fifty or a hundred trainees. In teaching a shop operation to one trainee, or to a class of twenty trainees, or to a small group of five or six, your work will be most satisfactory if you follow the four instructional steps—the warm-up, the presentation, the application, and the testing or check-up.

To be sure, the handling of these steps is different for individual instruction than for class instruction. For example, in instructing a class the time you spend in teaching each job must fit the speed of *most* of your trainees; yet you should arrange to keep your most competent trainees busy and interested while your less competent trainees proceed more slowly. With individual instruction, however, your instruction must be adapted to the learning speed of only one trainee.

In the first part of this chapter, we shall consider how to handle some typical lessons in individual instruction, in class instruction, and in group instruction. Then we shall watch some other instructors in action and note the methods they use in handling similar situations.

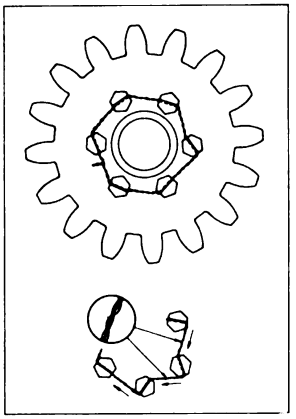

Figure 40—Installing safety wire

I. INSTRUCTING ONE TRAINEE

Suppose that you want to teach a single trainee how to install safety wire in aircraft cap screws (figure 40). Let us assume that he has had some experience as an auto mechanic and is anxious to learn what he can about the use of safety wire on aircraft.

The aim of your instruction is to teach the correct procedure for installing the safety wire in aircraft cap screws. You decide that your lesson could be considered successful if the trainee learns to install the double wire securely on six cap screws in a reasonable time.

A. THE WARM-UP STEP IN INDIVIDUAL INSTRUCTION

One of the best ways to arouse interest in this lesson is to explain what would happen if safety wire were not carefully applied. The trainee probably will want to know how to do a good job when he realizes that a gear which is held to a flange by cap screws might shear off those cap screws without correct safety wiring.

Discussing the materials of the lesson may also help to prepare him for it. You can show him samples of two kinds of single strand safety wire, one of brass and one of copper. He should also know that both these wires were annealed to make them less brittle. He is then ready to look at a sample of the double-strand twisted safety wire which is either two strands of copper wire or two strands of brass wire.

B. THE PRESENTATION STEP IN INDIVIDUAL INSTRUCTION

While the trainee is watching you carefully, demonstrate how to apply a single strand wire to cap screws. As you use the wire in this actual operation, keep in mind the key point of your instruction: the safety wire should be inserted in the correct hole so that any loosening of the cap screw will tighten the wire.

Then, show the trainee how to apply the double safety wire by passing one wire through the head of the cap screw, by passing the other wire over the top, and finally by twisting the ends together between the cap screws.

C. THE APPLICATION STEP IN INDIVIDUAL INSTRUCTION

Cut the safety wires from the cap screws and let the trainee install first the single and then the double safety wire. Watch him perform the operation, correct any mistakes he may make, and encourage him to do careful work. After he has made several installations, record the time it takes him to install the double wire in six cap screws.

D. THE TESTING STEP IN INDIVIDUAL INSTRUCTION

Inspect the trainee's work after he finishes it. Question him to make sure that he understands the job. You might ask him what the most important step in the process is, and how the wire can be inserted so that the screws cannot loosen.

The trainee may increase his speed by doing the operation over and over. Drill lessons are necessary if the trainee wishes to develop skill.

II. CLASS INSTRUCTION

In the lesson on safety wiring, it was easy enough to proceed at the rate which suited your individual trainee. In a class of 20, however, your instruction will be better if you use certain devices to provide for their individual differences. Suppose that you are going to teach a class in Aircraft Engine Maintenance how to

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adjust valve tappet clearance. Before the class opens, you can secure some information about their differences by looking up the training record of their previous mechanical work. If there is no such record, you need to study the personal data sheets of the trainees in the class.

Your objective is set up according to the accomplishment which you can reasonably expect from a group with such a background. For example, if most of them have done mechanical work for some time, they could be expected to achieve greater skill than if they were housewives now in a repair shop for the first time.

Your next step is to get ready for the lesson. Instead of arranging for one trainee to watch you work, you must now arrange all the equipment so that twenty trainees can see you at the same time. The engine to be used for the lesson should be set where everyone can see it; it must also be at the right height for you to work upon. To supplement and clarify the process, you select charts showing valves, rocker arms, camshafts, and cams. A cross-section of an engine would show the valve mechanism clearly. You consult the instruction manual for the selection of standard tools to be used on the job. The handbook of service instructions gives you information about the exact procedure for this particular engine. When all of your material has been selected and conveniently arranged, you might go through the steps of the lesson to become familiar with it. You cannot afford to waste the time of twenty trainees while you fumble in a demonstration.

Next, you must arrange to have the trainees' equipment and material ready for them to work on. Since it is unlikely that twenty engines ready for valve adjustment will be in your shop, you may assign each engine on hand to a group of trainees and ask each trainee to be responsible for certain valves. You must also check on tools and materials to make sure that an adequate supply is available for all trainees. For example, twenty thickness gages and twenty tappet wrenches should be on hand in the tool crib. If only ten of each are available, the work must be arranged so that half the trainees are measuring with thickness gages while the others adjust the valves with wrenches.

A. THE WARM-UP STEP IN CLASS INSTRUCTION

At the opening of the lesson, your introduction of the work should arouse the interest of the trainees by including some experience or question which will focus their attention on the adjustment of valve tappet clearance. Some trainees may be interested in why an engine loses power, misses fire, or causes undue noise in the valve adjustment parts. Others may be concerned about the effect of improper valve adjustment on valve timing. All of them will have more interest in their work if they understand its connection with previous jobs and with the job to follow. At this time, they need a clear definition of the term *adjusting valve clearance* and an understanding of its importance in engine performance.

B. THE PRESENTATION STEP IN CLASS INSTRUCTION

Next, you demonstrate how to do the job by going through the operations, step by step. This part of the procedure is the same for a class as for an individual trainee except that it is more difficult to work so that a large number can see you at the same time. You can use film strips to show them close-ups of operations which they could see only indistinctly at a distance. Then you can show them a valve assembly and demonstrate how the feeler gage is used and how adjustments are made. During your demonstration, make sure that your instructions get across. Question the trainees, and decide from their answers whether further explanation is necessary. The related information needs thorough treatment in connection with the demonstration. Calculations in decimals, the use of thickness gages, the difference in design of intake and exhaust valves, and the principles of operation of the internal combustion engine should be clear to all the trainees. Further, you must stress the safety precautions involved in the job so that the least alert trainee in the class understands how to avoid accident.

After the demonstration, question several of the trainees in order to determine what parts of the demonstration need to be repeated or what information needs to be reviewed or emphasized.

C. THE APPLICATION STEP IN CLASS INSTRUCTION

Giving 20 trainees a chance to do a job sometimes requires careful management on your part. If you have four or five engines, you can assign a small group of trainees to each one. If some of the trainees have had previous experience in adjusting valves and have shown understanding during the demonstration, you could ask them to do the job first. Check their techniques and their use of tools; then assign one experienced trainee to work with each group. While the trainees are at work, you should observe them and help them when they are puzzled or mistaken.

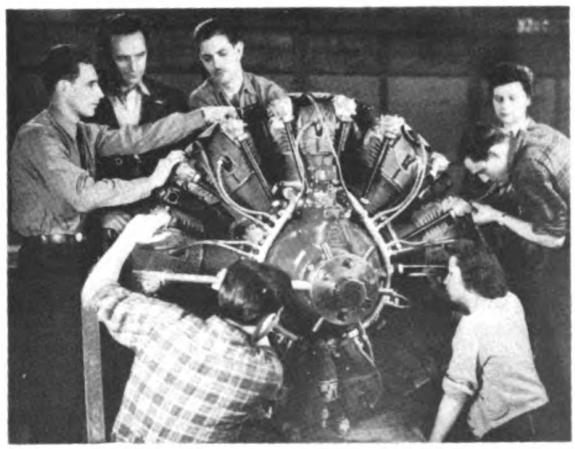

Figure 41—Applying the lesson

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D. THE TESTING STEP IN CLASS INSTRUCTION

Although you have been testing the trainees throughout the period by observing and questioning, you should make a final check on the ability of each trainee to do the job itself. Here the class instruction turns into individual instruction. While you inspect the valve adjustments done by a trainee, question him to see if he understands what he has been doing. Has he acquired the proper technique in using tools? Does he know the names and functions of the parts? Has he the right attitude toward the work he has been doing? Could he be trusted to do the job under different conditions? Would you trust him on a production job? Does he fully realize the responsibility involved in the job of servicing airplanes? None of these questions can be asked directly. Instead, you judge the answers to these general and basic questions by the way he answers specific questions about the job he has just finished.

III. INSTRUCTION OF SMALL GROUPS

Suppose again that you want to teach a group of four people how to adjust the valves on an engine. How do your preparation and planning differ from that of teaching an entire class?

Here are several of the important differences:

(1) You need not plan for the formal continuous demonstration necessary to the class session.

(2) You can ask each trainee more questions in your presentation.

(3) You can get the opinions of all the members of the group on important points.

(4) You may not have as great a range of individual differences.

(5) You can observe personally the progress of each trainee.

Just as important, however, as these differences are the similarities which you find between the two lessons:

(1) You use the four teaching steps: warm-up, presentation, application, and testing.

(2) You should make the same effort to warm-up the trainee for the new learning as you would if you were teaching a larger class. You can often tell by the expressions on their faces when they are interested in the lesson and ready to learn.

(3) Your preparation before the lesson should be just as thorough as though you were preparing for a large class.

Notice the importance of the four steps in any lesson. Whether you use a lecture, a conference, a discussion, or a demonstration, the best way to put it over is to use the steps of warm-up, presentation, application, and testing.

IV. INSTRUCTORS AT WORK

Let us look at some sample lessons and observe the way in which lecture, discussion, conference, drill, and demonstration are used in actual class sessions:

A. LECTURE

At an air depot, we are passing a classroom where the instructor is lecturing to a class on the variation of air pressure with altitude. On the blackboard you see a chart giving the pressures in inches of mercury at intervals of 1,000 feet, starting at sea level. Beneath this chart is written, "Note: There is an average drop of pressure of 1 inch of mercury for each 1,000 feet increase of elevation."

Figure 42—The instructor uses a picture

As we pause at this classroom, the instructor is telling the class that we live at the bottom of a vast expanse of air. This envelope of air extends upward to a distance of between 200 and 600 miles. At this point, the instructor shows a picture of a mountain whose height is 20,000 feet. The top is snow-covered but is steeped in sunshine. Clouds hover along its sides, causing cloudy weather in the valleys below. (Figure 42.) The lecturer continues to explain that all of this area shown in the picture with its tremendous range of variation in weather, temperature, and pressure, is included in the region called the *troposphere,* which extends for 6 to 10 miles above the earth. Above the troposphere is the *stratosphere* extending to a probable height of 50 miles. In the stratosphere there are few weather disturbances and a uniform constant temperature of 67 degrees below zero.

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We continue on our way, but we have observed two important things about lecture. First, pure lecture can be made an effective method of teaching by accompanying it with good illustrations. Second, pure lecture does not lend itself well to individual instruction, but should be used for teaching of classes or groups.

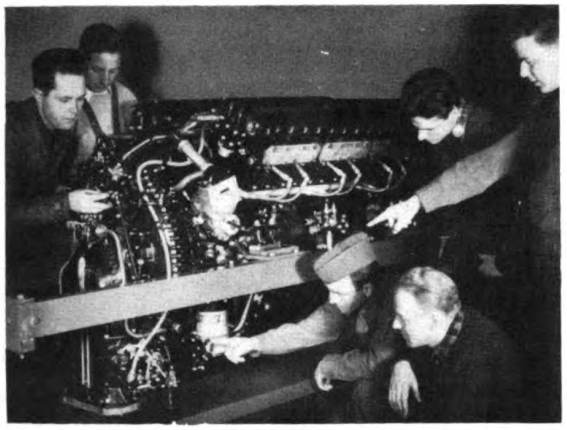

Figure 43—Shop discussion on ignition

B. DISCUSSION

Next, we come to a group of trainees who are studying aircraft engines. (Figure 43.) The job which is under discussion is the renewal of ignition wires on an in-line engine. The instructor has asked the question, "If the firing order is not indicated on an in-line engine, what is the best method for finding it?"

One trainee says, "I'd take off the valve cover plates, find out which valves are intakes and which are exhausts, then crank the engine and observe the order in which the intakes open. This will be the firing order of the engine."

Another trainee objects that it requires too much time to remove the valve cover plates when it is possible to determine the firing order by removing the spark plugs and observing the order in which the cylinders develop compression. He says that you can determine when a piston is on the compression stroke by holding your thumb over the spark plug opening.

The instructor suggests that he has only two thumbs with which to cover twelve spark plug openings.

At this point, a third trainee says that he usually loosens each plug two complete turns. Then, as he cranks the engine, he can hear the gas hissing from each plug, and in that way, he determines the firing order.

We should like to hear more; but we have learned that to have a good discussion, the people who take part must have a knowledge of the subject discussed. We have also noticed the stimulating effect of a good question. In this discussion, the leader caused a feeling of suspense by raising a question which created doubt in the minds of the trainees as to the soundness of their proposals.

C. DRILL

Next, we visit a classroom where twelve people are training to be inspectors of aircraft parts and materials. Each trainee has a shaft which is cut in steps to give ten different diameters. He also has an inspection report blank and a 1-inch micrometer caliper. All of the trainees are busy measuring the diameters, the dimensions of which are to be recorded on the blank. Readings must be accurate to within one one-thousandth of an inch. The instructor quietly explains to us that in this session the method of drill or of repeating an operation over and over is used in order to help the trainees. He also shows us the score sheets of several individuals in the class, and we are impressed with the differences in their work. Some of the trainees rarely make a mistake in measurement while others make many mistakes. The instructor explains that it is necessary to set up a minimum standard, and the trainees must repeat a given exercise until they have attained that standard.

This type of instruction by drill is equally well-adapted to the instruction of individuals, groups, or classes.

Figure 44—The instructor demonstrates

D. DEMONSTRATION

As we continue our tour of the depot, we find an instructor demonstrating to a group of trainees the method of applying fabric to an elevator frame. A little

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Figure 45—Explaining errors

farther on another instructor is demonstrating how the fabric is sewed to secure it to the frame. (See figure 44.) The instructor explains this procedure step by step and then asks one of his trainees to continue with the work while he corrects and explains the errors she makes. (See figure 45.)

It is important to follow the demonstration immediately with work in which the trainee applies or uses what he has just learned.

Demonstrations may be used for individual, group, or class instruction. Although it is sometimes necessary for an instructor to use models or mock-ups or enlarged views in a demonstration for a large group, demonstrations are most successful when used on the job with real parts and real tools.

After observing these various teaching methods, we conclude that no matter what method we choose, our instruction will be most effective if we use the four steps: warm-up, presentation, application, and testing.

QUESTIONS

(1) Describe what could happen if the safety wire mentioned in the lesson were not properly installed. How would you use this information in the lesson?

(2) What is a *key point* in a lesson?

(3) What is the key point of installing safety wire? Give examples of key points in other operations you are familiar with.

(4) What *basic pattern* is characteristic of the best instruction regardless of the method or number of trainees taught?

(5) In your instruction, how can you arrange to teach a large class when some tools and equipment are inadequate?

(6) Work out the four steps of a lesson on a single operation or principle that you expect to teach at the air depot. Show how you would adapt your instruction to fit a single individual, a large class, and, finally, a small group.

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Chapter 6

SPECIAL TEACHING PROBLEMS

The instructor finds out how to handle some of the special problems encountered in his work.

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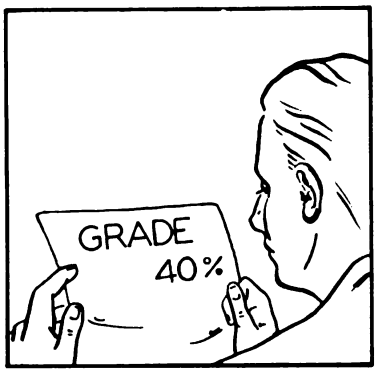
SPECIAL TEACHING PROBLEMS

What is meant by *special problems* in teaching? How can you aid trainees in developing good study habits? What can you do to develop desirable work habits? How can you stimulate interest and enthusiasm among trainees? What can you do when the trainees' progress is not satisfactory?



If all students had the same mental ability, if they were all interested in the same thing at the same time, and if teaching equipment and material were always excellent, there would be few teaching problems. Any variation from this ideal situation is sometimes thought to be a special problem. Actually, these problems are not unusual but are everyday problems of the classroom and shop.

You will need to recognize the exact nature of each problem, whether it springs from the personality of the trainee or from the amount and kind of equipment available. For example, one of your trainees may not want to learn because he does not like the place or is uninterested, while another may be so eager to learn that he cannot get enough information. Each one constitutes a problem, and the fact that both of them are in the same class makes another problem. You may have a wealth of material and equipment for instruction; or you may have the problem of improvising instructional materials to fill out an inadequately equipped shop.

Although these are the general sources of teaching problems, the behavior of your trainees will give you the first clue to a problem. Hence, the first step in dealing with any problem in a particular shop or classroom is to determine what is causing the difficulty in order to apply an effective remedy.

The following list includes some types of trainees who cause teaching problems. As an instructor you will need to recognize these types:

(1) *The faultfinding type* thinks nothing is right, criticizes job, depot, instructor, equipment, other trainees.

(2) *The domineering, bullying type* likes to boss the other trainees.

(3) *The irresponsible, thoughtless type* is likely to be careless about tools, inconsiderate of others.

(4) *The antagonistic type* has a chip on his shoulder, usually looks for trouble, gets into quarrels.

(5) *The overly aggressive type* is eager to get the job done at any cost to his fellow trainees and equipment, but he is not necessarily quarrelsome.

(6) *The time-wasting type* dawdles, talks, works slowly and lazily.

(7) *The timid type* is afraid of machines, of his instructor, of his fellows; works by himself, does not seek advancement.

(8) *The uninterested type* is inattentive, bored.

(9) *The unstable type* varies in mood and quality of workmanship; is not dependable.

(10) *The know-it-all type* has no use for instruction, always knows the best method himself.

(11) *The slow type* requires more time for each job.

Of course, there are many other trainees who have certain combinations of these and other traits; some of them will be discussed briefly toward the end of this chapter. Because of the great range of individual differences, however, it is impossible to list all the types that you will find, or to suggest solutions for all the difficulties they provoke. Further, a method recommended and used as a remedy in one case might not be effective in another. Each one should be treated as an individual problem. On the whole, however, the improper handling and misunderstanding of the types listed above create most of the problems you will encounter in helping others to learn.

After recognizing signs of trouble in the behavior of the trainee, exactly how should you go about solving the problem? For this purpose, you need to know now the sources from which problems arise. **IN GENERAL, PROBLEMS COME FROM THE ATTITUDES, APTITUDES, AND PERSONAL CHARACTERISTICS OF THE TRAINEES, OR FROM DIFFICULTIES IN MANAGING THE CLASSROOM OR SHOP.**

Attitudes are what the trainee thinks about his job, his surroundings, and his instructor. Since any trainee likes to be a member of a winning team, it is important that he should think his work as a whole is worth while.

Aptitudes are sets of characteristics which indicate a trainee's ability to acquire some kind of skill or knowledge. They are represented by what we do best and vary according to the person. One trainee has an aptitude for working with his hands. Another has an aptitude for experimental engineering or for teaching abstract subjects.

Personal characteristics are such qualities as patience, honesty, loyalty, courtesy, and initiative. All of your trainees possess some of these and other qualities needed for success, but many trainees may lack some of them. By careful study and guidance, you may help the trainees to develop these desirable qualities.

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I. SUGGESTED ADJUSTMENTS FOR PROBLEM TRAINEES

After you have considered these general sources of problems among your trainees, you are ready to select remedies for your particular problem. You may handle each troublemaking trainee in a number of ways. Sometimes one solution works successfully. At other times, you have to try several solutions either separately or in combination.

In the following chart are shown a number of suggested adjustments the instructor might make to remedy the situations found in dealing with several different types of trainees. Check marks are used to denote which adjustments are recommended, with the larger check mark indicating the more promising adjustments for those cases. No attempt has been made to indicate all of the things that might be done. You will need to study each case carefully, and apply one or more remedies which appear to fit. When you have learned to select and apply the correct remedies for difficult situations, you have mastered one of the arts of instructing.

The purpose of this chart is simply to suggest to you the endless possibilities of getting the best results from your teaching. The next few paragraphs indicate the way in which you might use this chart.

For the irresponsible trainee who dodges his obligations or who assumes them with no intention of carrying them out, you should begin by finding out about his background and interests. If he is a mature person who has been successful in machine shop work, he is likely to lack interest in an assignment to depot supply. For these occasional cases of ill-advised assignment, the best solution is an immediate transfer to an appropriate branch of training, if possible. Usually, however, an inexperienced trainee can develop an interest in the instruction and, consequently, a sense of responsibility about it. You might tell him in a friendly conversation why his marks are low, and that assuming and carrying out responsibility will require determined effort on his part. His enthusiasm for this project may be enlisted if he appreciates the importance of his job. Tell him what might happen to the operator of a plane if the trainee's job were not carefully done. Picture to him the unfailing responses to the controls which an airplane must give, and the beauty and accuracy of the flight of a plane which is built with precision and checked with care.

After he understands his share in keeping our planes in excellent condition, give him a definite but reasonable assignment. At the end of the time allowed, check his work very carefully, and discuss your findings with him. Praise him if he was successful wholly or in part. Point out the ways in which he might improve. If he has failed to carry out the assignment, find out why he thinks he has failed. Explain to him that he must assume more and more responsibility with this training.

If he is inclined to brag, set higher standards, and get him to prove his ability in his next assignment. If he is quiet and unresponsive, ask him to suggest ways in which you could help him to carry out his assignments. In any case, ask him to do his next work with several other trainees who are dependable. Make sure that this particular trainee is responsible for a definite part of the assignment on which he can be checked. As you continue to work with him on his problem, praise him for work well done, and show your disappointment when he lapses into his old habits of carelessness.

The trainee who knows it all presents a different problem. His record might show that he has been working on a job that does not challenge his ability. You might also find out that what he believes he can do is far in advance of his ability. In the shop, you can then give him more work and more responsibility while you arrange to check him carefully to make sure that he is doing his assignments correctly. Give him special assignments that tax his ability to the utmost. If he cannot measure up to his estimates of himself, he will welcome a change back to an easier job that will keep him mentally and physically occupied. In the meantime, you could ask him to do special jobs of responsibility for you, and appeal to his sense of loyalty in carrying them out. Gradually, he is likely to begin to follow the group pattern and become a help rather than a hindrance to the work of the class.

The trainee who is emotionally unstable can best be approached in a private conversation after you have looked up his background and interests. He may not be able to take criticism gracefully, or he may become unduly excited at examination time, or he may lose his temper frequently in everyday shop work. You can begin by telling him what you have observed about his emotional reactions. It is likely that he would be interested to know specific ways in which these emotional excesses hinder his progress in the job, and that he would be encouraged by the comment that he could learn to overcome them. He will appreciate being told that you are willing to co-operate by explaining anything in the course which he does not understand, and to remind him quietly when he is about to lose his poise.

If the trainee is nervous in examinations, go over his work with him slowly to make sure that he understands it. Give him the privilege of asking additional questions, particularly just before an examination. Then, tell him that you will accept his next examination paper if he will write one-half of the total number of answers carefully and correctly; that in each following examination you will expect him to write a greater proportion of them correctly. If this method fails, you should advise a physical check-up to find out whether his emotions reflect a state of health which might be improved. In the meantime, you could depend on other tests of his ability, such as oral questioning or observing his performance on actual jobs.

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SUGGESTED ADJUSTMENTS	TYPE OF TRAINEE										
	FAULT-FINDING	DOMINEERING	IRRESPONSIBLE	ANTAGONISTIC	OVERLY AGGRESSIVE	TIME-WASTER	TIMID	UNINTERESTED	KNOW-IT-ALL	UNSTABLE	SLOW LEARNER
Find out about trainee's background	√	√	√	√	√	√	√	√	√	√	√
Give more individual instruction							√			√	√
Find trainee's major interest	√		√			√		√		√	
Tell trainee why record is poor	√	√	√	√	√	√	√	√	√		
Show trainee how to improve	√	√	√	√	√	√	√	√	√	√	√
Be patient in correcting mistakes							√			√	√
Give no chance to dodge responsibility			√			√			√		
Provide situations for successful accomplishment							√	√			√
Establish a rigid check on trainee's work			√		√	√			√	√	
Teach only one thing at a time											√
Let trainee know what is expected from him		√	√	√	√	√		√	√	√	
Listen to grievances and determine if they are valid	√										
Appeal to trainee's sense of fair play	√			√							
Change work stations or partners		√	√					√			
Provide more work for trainee					√				√		
Provide less work for trainee											√
Give trainee more responsibility									√		
Give more difficult assignments					√				√		
Require trainee to prove his ability									√		
Arrange for medical examination										√	
Have trainee work alone	√	√		√							
Have trainee work with others							√				
Redirect his energy into useful channels				√	√						
Keep trainee informed of his progress	√	√	√	√	√	√	√	√	√	√	√

Figure 46—Suggested adjustments for problem trainees

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The adjustment chart, as you have probably observed, has served as a guide in the treatment of these trainees. But in following its suggestions, you need to use your own good judgment. In many situations, you also need to devise other remedies.

Now, let us consider the treatment of other types of trainees you are likely to find in your classes.

II. THE TRAINEE WHO DOES NOT PUT HIS TOOLS AWAY

If you have ever seen a shop where the tools, equipment, and work projects lay about the room in disorder, you may be certain that fundamentally the instructor or supervisor was responsible. One trainee who does not put his tools away can start a careless spirit in the shop that leads to general confusion. It is important, then, that you check carefully to see that the trainees take care of their tools and equipment. You might point out to them that putting the tool away is just as important as using it in the first place; for if a trainee puts it back on the rack, it may be used by hundreds of careful trainees; but if he leaves it under a machine, it may be lost or thrown out with the refuse.

The arrangement and facilities of the shop itself, of course, are basic in encouraging the trainees to keep order. Arrange the stock room systematically and conveniently; provide tool racks that are handy to the job; give the trainees a definite place to put their work projects. Then, allow no exceptions to the rule that at the end of each work period after each job, all tools must be on the rack, all equipment and materials returned to the stock room, and all work projects in their place. In this way, all trainees will acquire the valuable work habit of neatness. If one of their number is careless with the tools, they will quickly exert pressure on him to conform with their standards of orderliness.

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III. THE TRAINEE WHO DOES NOT KNOW HOW TO STUDY

You may discover that one of your trainees who spends a considerable amount of time preparing his work seems poorly prepared when you question him in class. It is likely that he has not developed good study habits. Perhaps he will tell you that while he is studying, his attention is easily distracted by a noise, the movement of a person in the room, or a change in the weather. For him and other conscientious trainees with the same difficulty, the following tips on how to study might be helpful. You can make these suggestions more convincing if you show him how you have used them in your own work.

(1) Good health makes study easier. Plenty of good food, fresh air, rest, and exercise are necessary to keep you in good physical condition.

(2) Study your most difficult problems when you feel rested and refreshed.

(3) Arrange a definite time each day for study, and let nothing interfere with your schedule.

(4) Make lists of facts, or outline important procedures that you want to remember. Devise tables and charts, and draw your own sketches. All of these notes help to fix the material more firmly in your mind, and they will be helpful in review.

(5) Read through the study material quickly at first. Then, read it carefully the second time, and concentrate on the details. Ask yourself why the given procedures are necessary.

(6) Try to figure out the questions that the instructor is likely to ask, and then work out good answers that you would like to give in class.

(7) Apply the information you have learned to real situations, if possible. Talking about it to your fellow trainees may help everyone to remember it.

(8) If there are any key facts that you think you should have at your command, memorize them by frequent and thoughtful repetition.

Anyone can form good study habits by following these suggestions, until it is easier to use such a system than to do otherwise. Even competent trainees can improve their work by increasing their efficiency in study.

IV. THE TRAINEE WHO FORGETS

You can give a great deal of help to the trainee who is quick to say, "I forgot," and who offers poor memory as an excuse. If he consistently asks you questions which he could answer by himself, you will increase his efficiency in the long run by telling him where to find the answers. For instance, a trainee who has forgotten the firing order of an engine could be told good-naturedly to look it up in his manual. On the job, he will be expected to know or to find such information without assistance from the supervisor.

You could also show him how to improve his memory by careful organization and thoughtful repetition. If you wanted to teach him that the firing order of a certain engine is 1, 3, 5, 7, 9, 2, 4, 6, 8, you could say these numbers in this order as you point to the cylinders of the engine. You could also ask him to repeat them after you while he points to the cylinders. Then you might remove the distributor cap from the magneto and show that the wires from the plugs must be placed in the cap in the order of 1, 3, 5, 7, 9, 2, 4, 6, 8. By this time, he must have noticed that the engine fires alternate cylinders as the crank shaft rotates. In other words, No. 1 cylinder fires, No. 2 does not, but No. 3 fires next, until all have fired. This explanation will also bring out a simple memory device; the order is almost unforgettable if the trainee notices that it proceeds by *odd numbers* through 9, and then by *even numbers* for the rest of the cylinders.

Finally, the trainee could clinch this knowledge if he were given a chance to replace the spark plug cables in the engine according to the correct firing order. After thus learning by seeing, hearing, and doing, the trainee could be held responsible for this information, and he would be unlikely to use *forgetting* as an excuse. By following this procedure, you are really showing the trainee how to learn; he can be encouraged to follow these suggestions when he studies by himself.

V. THE TRAINEE WHO CANNOT EVALUATE OR ORGANIZE

Good instructors rarely have trainees who say, "I don't see why I should learn this. I'll never use it anyway." Such an attitude can be avoided if the instructor explains clearly how the new lesson is related to material already taught and to skills which all competent workers in this field must have. Sometimes a complaint of this kind from a trainee also suggests that the instructor has been giving the trainees information which would be nice to know but not necessary. In other words, you cannot expect all trainees to have a reliable sense of values about unfamiliar work, but you can help them learn to evaluate as you go along in the training course. Your emphasis on certain parts of the instruction should provide a reliable guide for them.

Sometimes a poor sense of values is the basic problem for a trainee who has too many outside activities. This trainee may be in classes at the depot at the same time that he is doing a part time job elsewhere and carrying much responsibility in his home. No one can expect to do good work under such conditions. A frank talk with such a trainee may help him to decide which activities should receive his major effort, and how to abandon or fit the others into a reasonable schedule.

VI. THE TRAINEE WHO DOES NOT TRY TO DO A GOOD JOB

Since there is a tendency for the performance of the group to seek the level of that of your poorest trainee, it is your constant concern to develop high standards

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of workmanship. In general, your enthusiasm for precision in the work and your interest in the newest developments will stimulate the entire group to a high level of performance.

Sometimes, however, in a generally satisfactory group, one trainee may tend to do the minimum. His attitude may by; "Why should I spend extra time working on this job? I'll never get any credit for it. I'll do just what I have to, and no more." The key to his attitude is often that he has given his best to some project in the past, only to be criticized unkindly for his accomplishment. If you encourage him to tell you about this old grievance, you have gone a long way toward winning his confidence. You can also point out to him that successful persons are usually willing to do more than is required of them. If he is interested in earning more money or achieving social recognition, he may be impressed by the connection between his attitude and his future success.

On the rare occasions when a trainee cannot be persuaded by this reasonable appeal, you might try treating him like any adult who is quite competent to decide what he wants to do but who must recognize the penalties involved. You might tell him quite frankly that he can do as he wishes so long as it does not interfere with the others in the class, that you are sorry to see him satisfied with anything less than his best work, and that you will be pleased if he ever even slightly changes his attitude. As he experiences the impartial disapproval resulting from his attitude, he is likely to wish to regain a position of respect. Be sure to allow him to save his face, and watch constantly for any evidences of co-operation for which you may commend him quietly.

Other trainees who do not try to do good work appear to be lazy. Sometimes such laziness results from some physical condition which can best be detected by a physical examination. With other lazy trainees, the instructor may well follow the procedures suggested for the Timewaster on the chart.

VII. THE TRAINEE WHO DOES NOT APPLY HIS KNOWLEDGE

It is up to the instructor to show trainees some of the applications of the basic material taught in the class. Trainees must not only recognize fundamental principles, laws, and general statements, but they must also understand where and how each one should be used. Frequent references to these applications prevent the trainees from getting into the habit of memorizing facts without understanding their meanings.

Some trainees, however, resist making their own applications of useful facts. A patient instructor might teach a valuable lesson in electricity to a thoughtless trainee in the following way:

Trainee: "What would happen if I should connect this piece of copper wire across the 110-volt power line?"

Instructor: "What is the resistance of the wire?"

Trainee: "Oh, about 1/100 of an ohm."

Instructor: "What is the rated current capacity of that wire?"

Trainee: "Twenty amperes."

Instructor: "Wouldn't it be a good idea to use Ohm's Law to figure out what would happen?"

Trainee: "Say! It would be overloaded, wouldn't it? We learned Ohm's Law for dry cells, but I never thought of using it on 110-volt set-ups."

In this way, a trainee may be shown how to apply his information successfully; and if he shows special interest, he might be asked to find other practical applications of Ohm's Law. He is thus learning a habit of thought that will be useful to him all his life.

VIII. THE TRAINEE WHO CANNOT DO THE WORK

Training courses are usually built on knowledge common to most of the persons likely to be in the depot. If a trainee lacks part of this usual background, he is at a disadvantage. For example, a trainee who lacks skill in simple arithmetic is likely to have difficulty with much of the work offered at the depots. Such lack of training is usually easy to detect either through his school records or by his own statements. Sometimes lack of background becomes apparent only through repeated failures in certain kinds of work. If the trainee is really interested in improving, he can do extra study under your direction to make up the training he has missed. Perhaps he needs only a review to make usable some knowledge that he has forgotten.

If a trainee is consistently unsuccessful in spite of all your help, it is possible that he simply lacks the ability to do the work. You should decide that lack of ability is the cause only after carefully considering the other possibilities. You might also arrange to have him given a series of simple tests to determine the accuracy of your judgment.

When the trainee lacks mental ability, you should decide whether or not he could be trained to be useful in your field. He may be unable to understand mathematics, or he may be unable to organize and plan. In either case, it might be possible to train him for certain jobs in the depot. Often, however, you should advise the trainee to shift to another job which he is capable of doing.

When the trainee lacks physical ability, you may detect and advise him about defects that can be remedied. Be particularly alert for defects of sight and hearing.

IX. YOUR ATTITUDE TOWARD PROBLEMS

When you take a job at a new plant, you rarely expect to find excellent equipment, short hours, convenient working arrangements, large salary, congenial co-workers, and lenient employers. You consider yourself lucky if the plant offers several of the advan-

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tages which are most important to you. As an instructor, also, you cannot expect that your trainees will all be brilliant and co-operative, that your superiors will always be reasonable and agreeable, and that the facilities will be flawless. Part of your satisfaction in the job comes with successfully overcoming obstacles to good instruction.

One of the best tests of your cleverness may come in adapting your instruction to poor equipment and inconvenient housing facilities. There is no way of anticipating all of the solutions which could be devised to meet these situations. Some of them you will discover by talking to other instructors; others you will figure out for yourself.

If you were used to working on engines in a warm shop, how would you plan to instruct trainees in a cold hangar where your hands grow numb as you work? You might decide to permit rest periods so the men could warm their hands, or you might arrange for some of the work to be done in a small heated room nearby.

Suppose you were teaching a class in instrument repair and needed a vacuum pump to test the instruments. If one were not available through the usual channels, could you improvise one from an old device formerly used for spraying an automobile windshield?

These are only a few examples to suggest the attitude which will help you overcome such inconveniences. If you ever get discouraged, you might remember the instructors in Chinese universities whose equipment had to be carried a thousand miles inland by the students, and who have been teaching in mud huts where the only chairs had to be made of hardened earth. In spite of all their difficulties, these instructors have inspired the youthful Chinese with an eagerness to learn that is rarely found in other countries.

The more elusive obstacles created by the clash of personalities may be present in the depot as in other walks of life, and your attitude can be constructive providing you remember the urgent demands of war. Jealousies and antagonisms should be smoothed out if possible, ignored if necessary, but never permitted to interfere with the war effort.

In dealing with the trainees, we must remember that we must possess the good qualities which we try to help them develop. Moreover, we must control any undesirable traits which we are likely to criticize in the trainees. The attitude of the instructor toward his job, toward his fellow workers, and toward his trainees has a great influence upon the class. If an instructor is slipshod about his work, the trainees are likely to be careless also. If he does not have a wholesome attitude toward his work, it is impossible for him to develop desirable qualities in the trainees. In your very first meeting with the trainees, they will form an opinion of you and of what they see in the shop or class. These first impressions are often lasting impressions. The instructor who seems to be in command of the situation, who has a definite aim, and has his work organized to achieve this aim, has gone a long way toward avoiding special problems. He has created an atmosphere that encourages good teaching and successful learning.

QUESTIONS

(1) Think of a faultfinder among your acquaintance. List his attitudes, aptitudes, and personal characteristics in an effort to find the source of his difficulty. How would you handle him in a class? What admirable qualities could he be praised for at the same time that you were helping him overcome his troublesome habit of faultfinding?

(2) What material in your instruction may be difficult for a trainee to remember? How can you help him organize this material so that he can keep it in mind?

(3) What constructive reply can you make to the trainee who says, "John Jones didn't do this, so why should I?"

(4) What fundamental principles in your specialty need to be applied frequently by the trainees? How could you encourage them to apply their knowledge instead of asking you unnecessary questions?

(5) What procedure would you use for the timid trainee in your class?

(6) How can you help your trainees develop good study habits?

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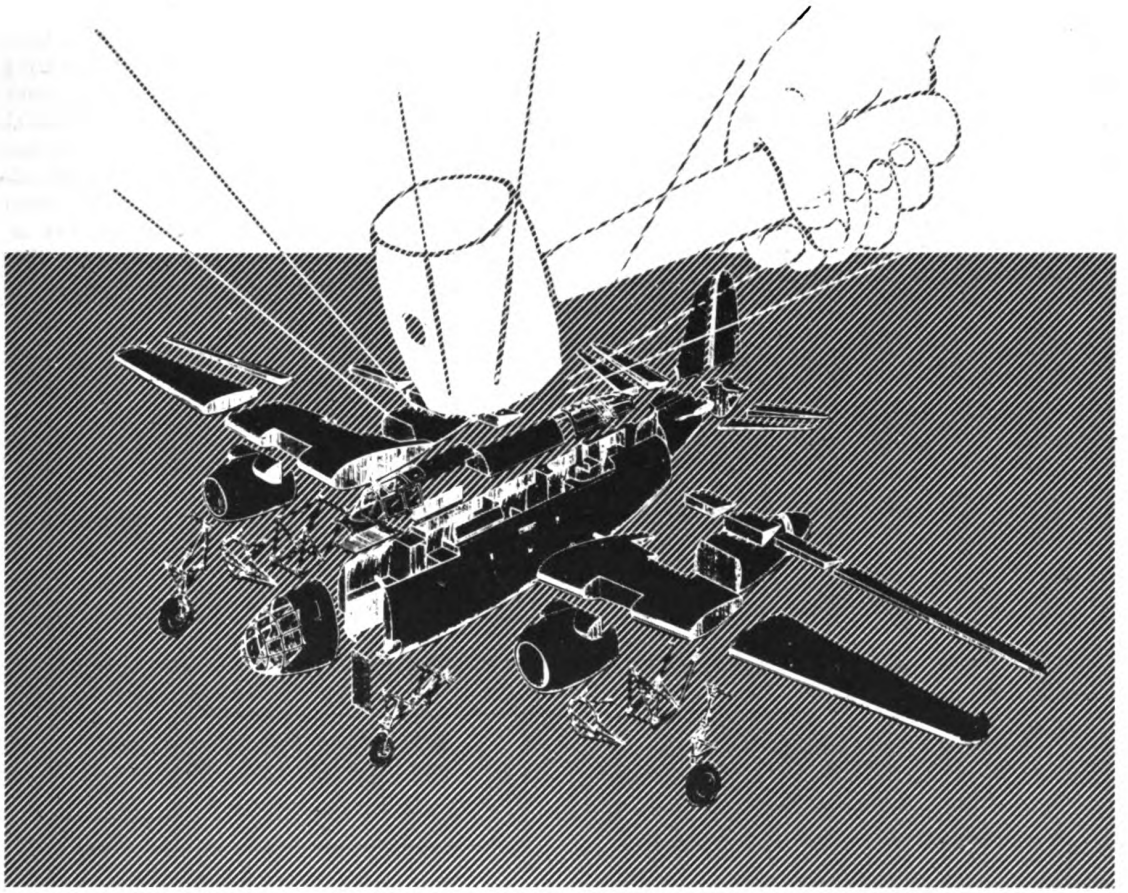
Chapter 7

BREAK-DOWN OF A JOB



The instructor studies the things to be taught, and breaks the content down into suitable teaching units.

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BREAK-DOWN OF A JOB

The good instructor knows how to teach and what to teach. He knows the principles of learning and of teaching. He knows the content of the occupation.

The structure of vocational training is built on foundations of *occupational content* and trainee *ability and background*. Courses of instruction rest upon occupational analysis and the principles of learning and of teaching. Effective teaching is based upon well-selected instructional material and well-planned lessons. (See figure 48.)

The preceding chapters have dealt largely with the trainee and with methods of teaching. This chapter deals with the content to be taught and its break-down into suitable teaching units.

One of the problems in teaching is to decide what you are going to teach, and how much to teach at one time. Most new instructors try to teach too much at one time. They expect the trainee to know almost as much as they do. They forget that what seems simple to them may be very hard for an inexperienced trainee.

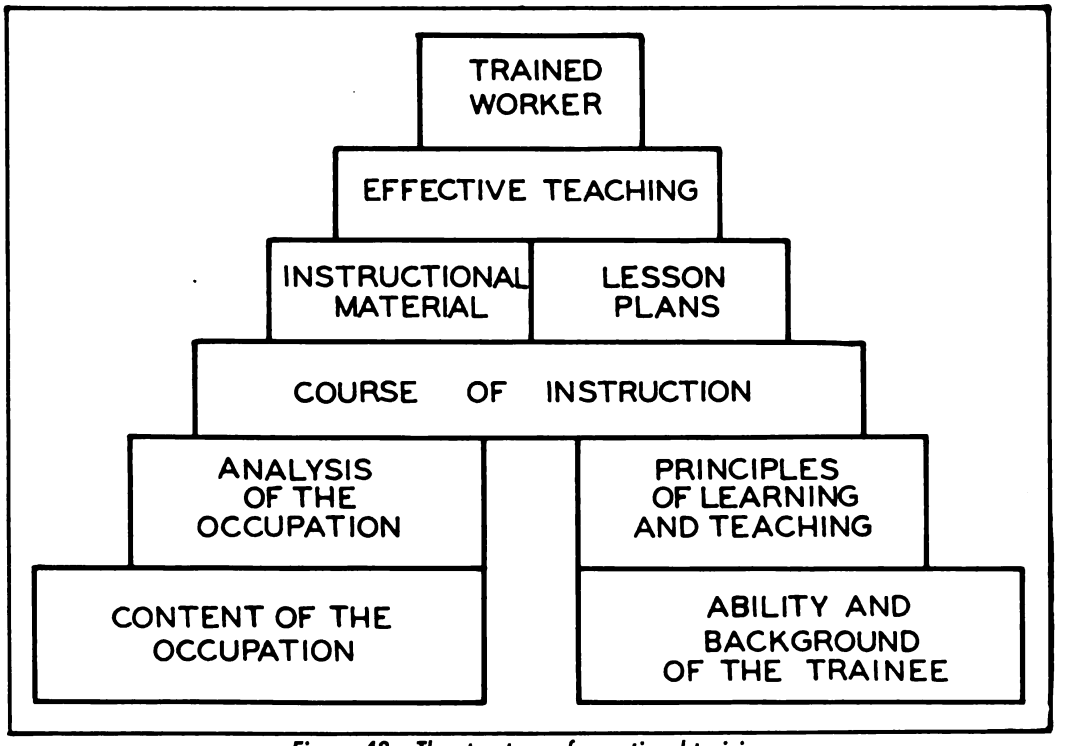

Figure 48—The structure of vocational training

On the job you have been interested in increasing your own efficiency as a skilled worker. Now, you must look at that job from a *beginner's* point of view. The beginner needs to get his learning in small doses. If you are going to get results in teaching beginners, you will need to break down your job into small parts, and to teach these small parts one at a time.

How can that job be broken down so that the trainee will understand the parts and see their relationship to the whole job? Within each part, how can you find out the points that need to be emphasized if the trainees are to learn quickly and easily?

A good way to start is to take the job as a whole and first break it down into larger divisions. Then these can be broken down into smaller and smaller units, until we get them to the size which can be handled.

I. JOB BREAK-DOWN FOR DEPOT SUPPLY

Let us look at the break-down we might use for teaching the various aspects of *Depot Supply*. In some depots we find that the main divisions of the work are Inspection, Purchasing and Contracting, Receiving, Shipping, Warehousing, Property Accounting, and Maintenance Liaison. Suppose we were concerned chiefly with Receiving and desired to break this division down further. We may divide this into two main subdivisions: Office and Floor Work. Each of these in turn may be broken down still further. The chart shown in figure 49 shows a number of these smaller subdivisions. You might classify the items somewhat differently, yet, in general, you would have a series of small subdivisions similar to the ones shown in the chart.

II. JOB BREAK-DOWN FOR AIRCRAFT MAINTENANCE

If you were to look at the whole job of *Aircraft Maintenance* and wanted to break this down into divisions and subdivisions, you might find five major

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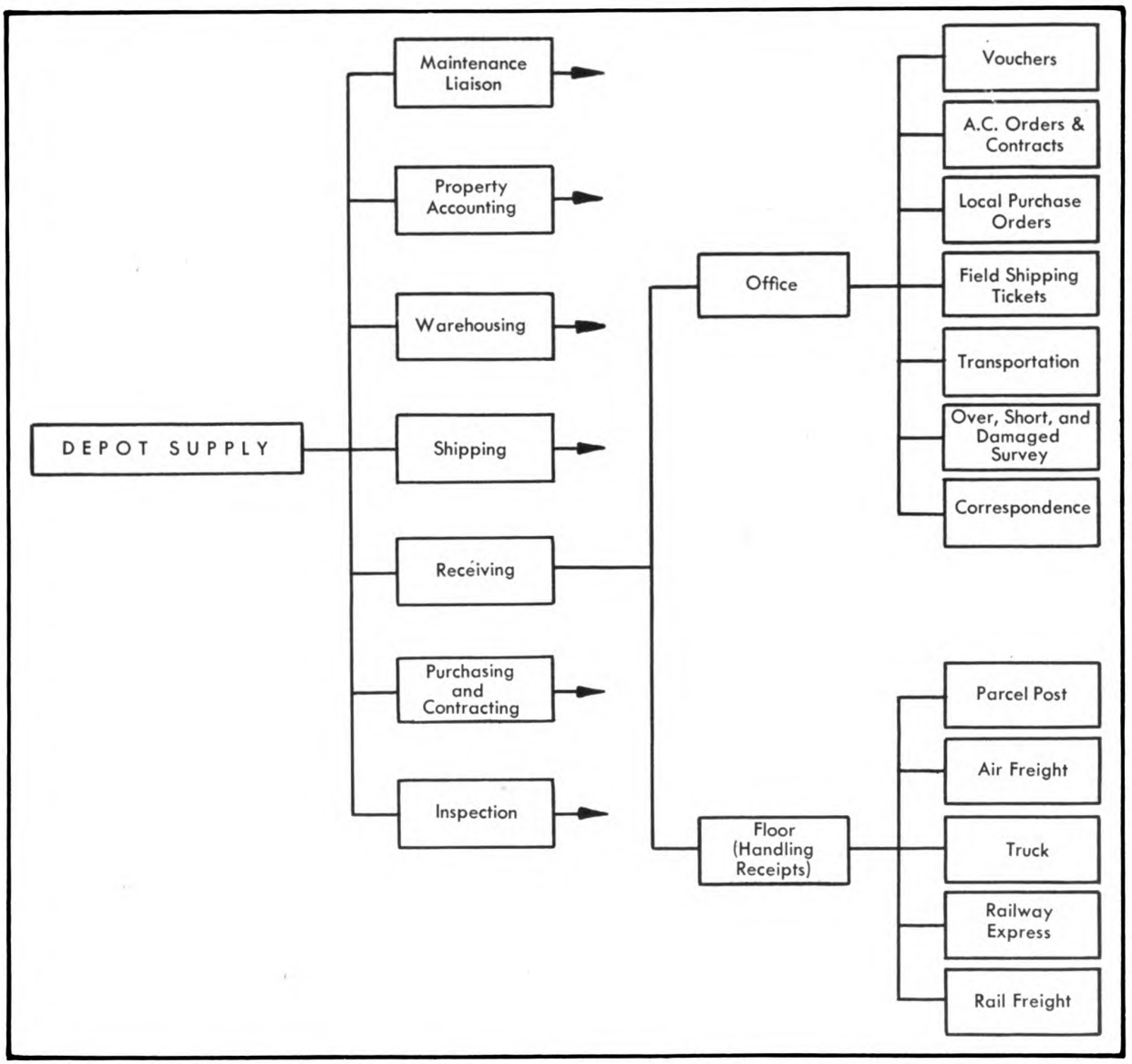

Figure 49—The break-down of depot supply

divisions, as shown in figure 50. These are Engine Repair, Metal Manufacture and Repair, Equipment Repair, Aero Repair, and Miscellaneous Repair. Each one of these main divisions can be broken down into subdivisions. And these subdivisions can be broken down into smaller units.

Let us take the division of Aircraft Engine Repair and follow through part of the break-down of this division. We might find that this is made up of five subdivisions: Cylinder, Piston and Valve Repair, Engine Small Parts Repair, Spark Plug Reconditioning, Supercharger Overhaul, and Crankshaft and Reduction Gear Repair, as shown in figure 51.

Each one of these kinds of engine repair is made up of many divisions. Some of these divisions for Cylinder, Piston and Valve Repair are shown in figure 52. Perhaps you can think of others that might be included.

It might seem that the job break-down had been carried far enough, but an efficient instructor will subdivide these units still further and will list the operations necessary for each one. In figure 53 is shown a summary chart of the various divisions we have mentioned, together with a break-down of the Measurement of Cylinder Bores into some of its operations. In this chart you will notice that on each level of subdivision only one part is selected for further break-down.

These charts are more than mere pictures of what happens in the break-down of one small part of the occupation of aircraft maintenance. They show the

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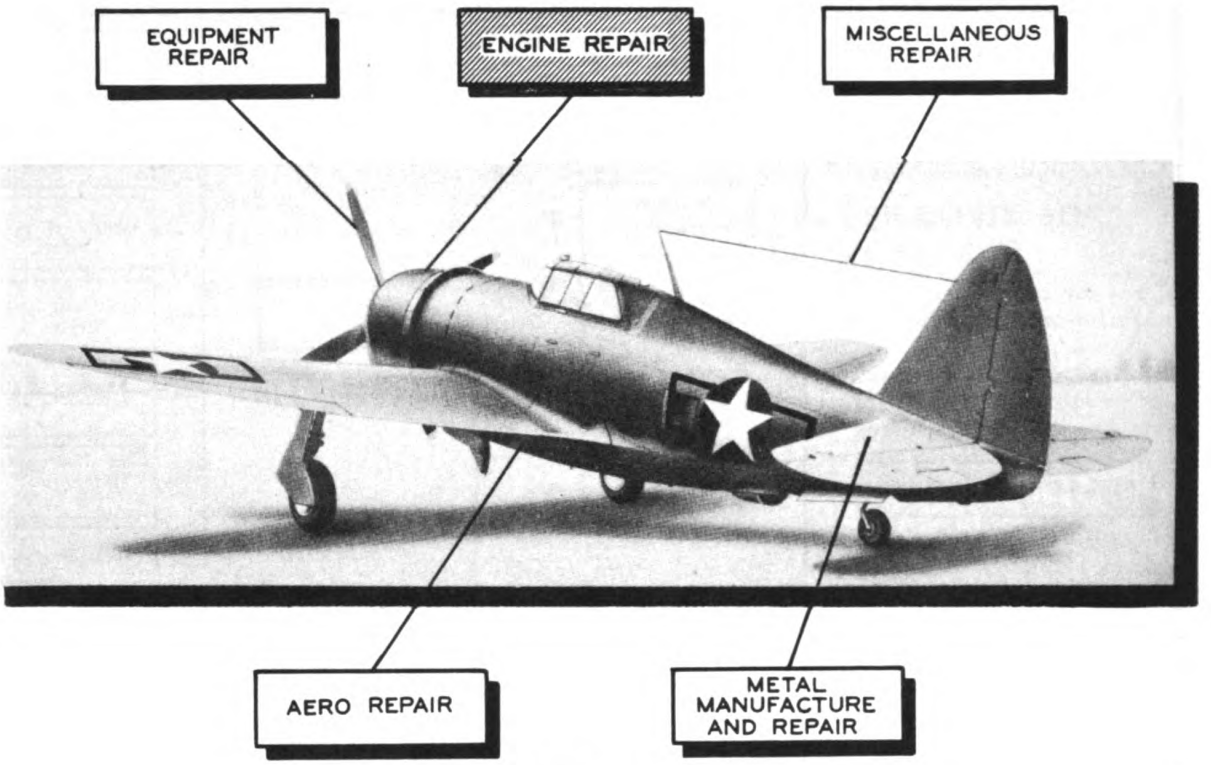

Figure 50—Major repair groups

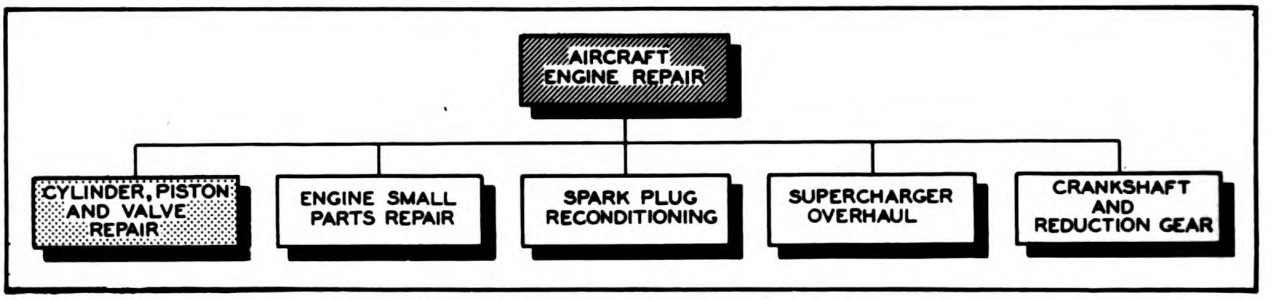

Figure 51—The break-down of engine repair

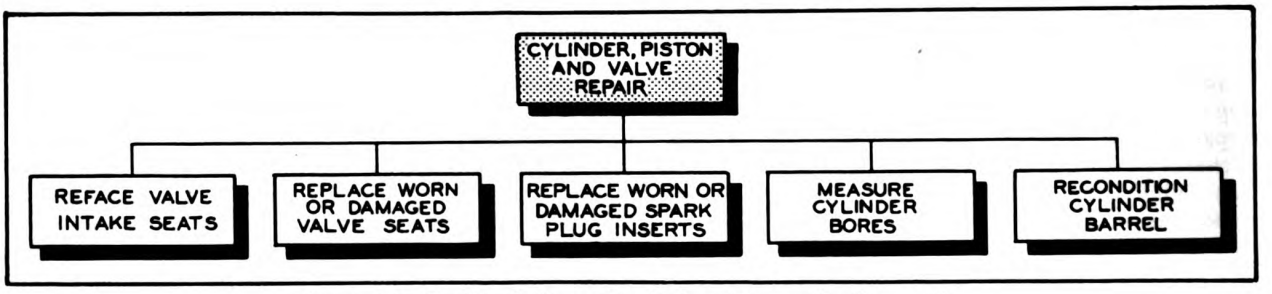

Figure 52—The break-down of cylinder, piston, and valve repair

best method by which you can break down the occupation in which you are working. You will find it helpful to take the divisions in your occupation and actually put them in this chart form.

If you have carried the job break-down to this point, you can explain clearly to your trainees the jobs they will learn to do, and the relation of these jobs to the whole field of aircraft maintenance.

Although this over-all view of the occupation is necessary, it does not tell you exactly what operations to teach, and what points need to be emphasized if the trainees are to learn quickly and easily.

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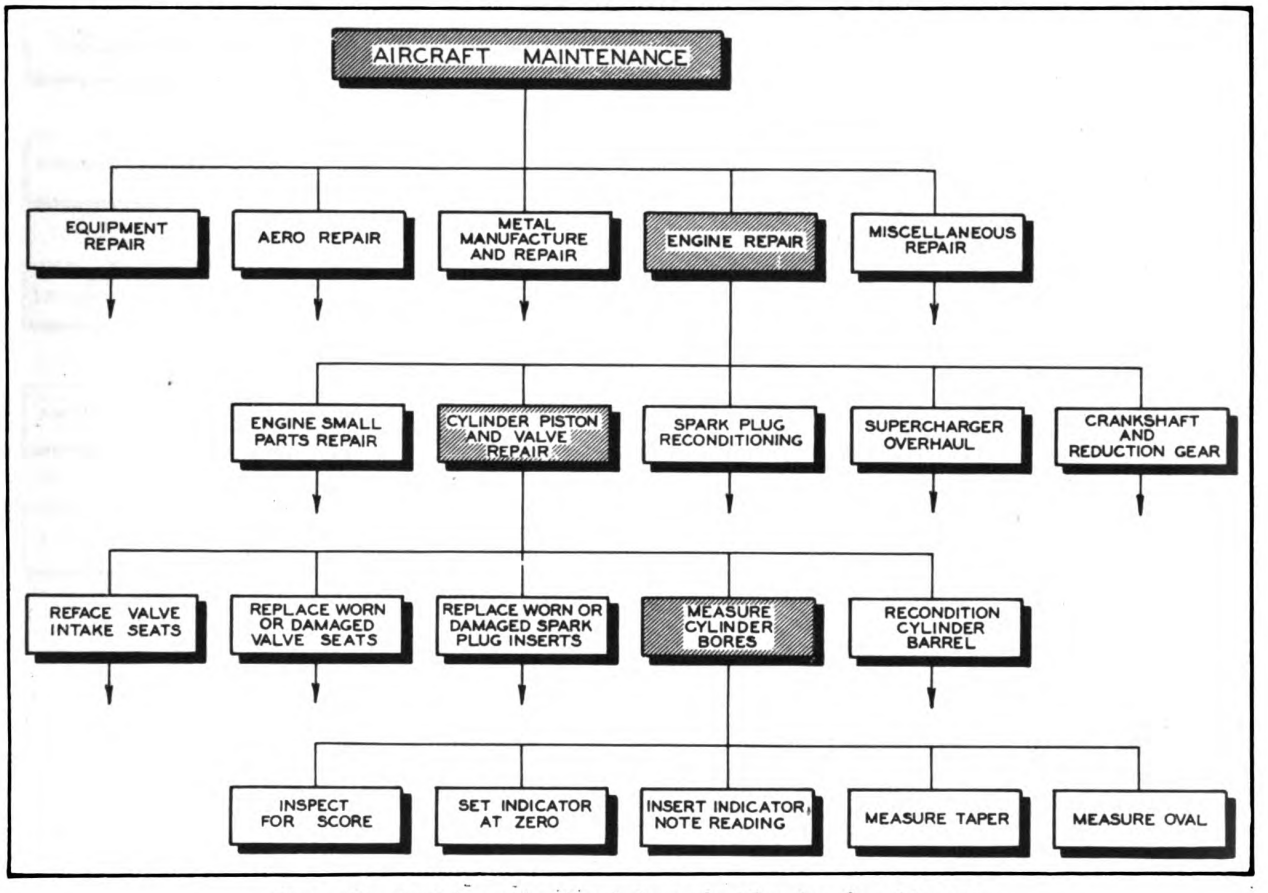

Figure 53—Partial summary break-down chart for aircraft maintenance

No matter what subject you teach—shorthand, teletype, warehousing, or sheet metal work—you must break it into jobs small enough for each lesson. A more complicated job can be covered with advanced students because they may be familiar with some of the operations in it. A simple job must be planned for beginners.

In any subject, you can find out how difficult a job is by considering the number of operations or steps needed in it, and particularly by noticing whether or not those operations are new to your group of trainees. If a job requires a long series of operations, most of them new to your trainees, it should be subdivided so that you can teach it to them one step at a time in a series of lessons.

III. JOB BREAK-DOWN—INSTALLING TURNBUCKLES

Suppose you are listing the operations in a simple job like the installation of a turnbuckle for a group of trainees beginning a course in structural repairs for airplanes. As you may know, turnbuckles are adjustable connections used to adjust and maintain proper tension on tie rods, control cables, and brace wires. For example, the tension on the elevator and rudder control cables is adjusted by turnbuckles, as shown in figure 54.

The best way to find the operations needed for any piece of work is to jot them down while you watch someone do the job, or while you imagine yourself doing it. In figure 55, you can see how you could break the job of installing a turnbuckle into six operations.

Up to now, you have been thinking of the job in terms of the skills needed for *operations.* Perhaps you have already wondered when *related information* would be considered. You know that related information is the knowledge a trainee must have at his command before he can become skillful on any particular job. Naturally, then, this information directly concerns the operations that make up the job. Since it must be referred to or taught in connection with the operations, the items concerning such information must be listed on the same sheet with the operations.

In the break-down sheet shown below, you will find a practical way of arranging the break-down into operations and related information for the installation of a turnbuckle. On the left half of the sheet, you list the operations. On the right half, you list what the trainee must know in order to perform the operations.

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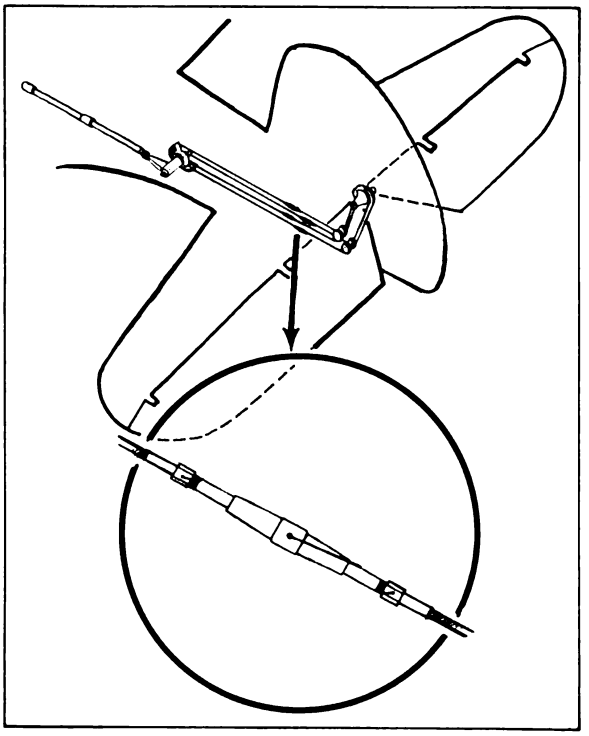

Figure 54—A turnbuckle installation

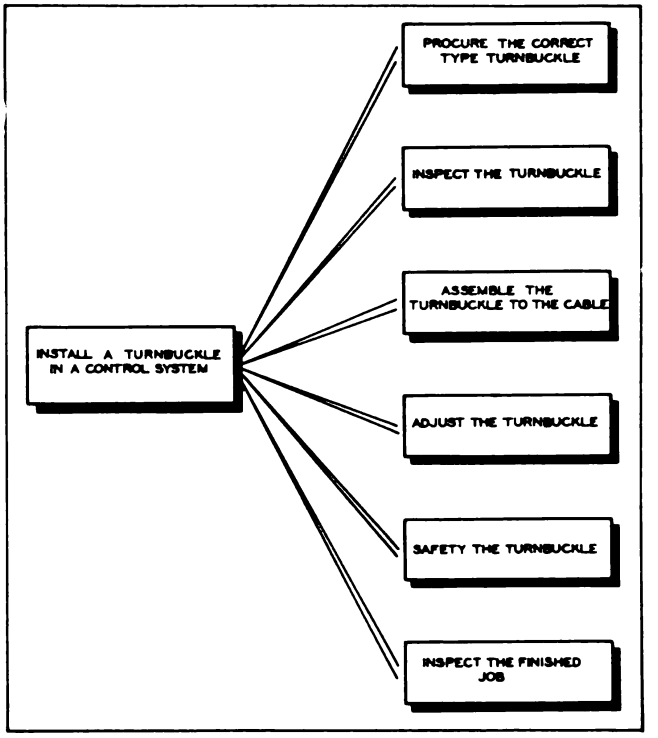

Figure 55—Break-down of turnbuckle installation

JOB BREAK-DOWN SHEET

INSTALL TURNBUCKLES IN CONTROL SYSTEM

Operations WHAT THE LEARNER MUST DO	Related Information WHAT THE LEARNER MUST KNOW
In this column, list the step-by-step procedure which the workman goes through when performing the job.	In this column, list the information directly related to and necessary for the performance of the job.
(1) Procure a turnbuckle of the type required for the installation.	Turnbuckles have a right-hand thread on one end and a left-hand thread on the other. Turnbuckles are obtainable with different types of ends, the forked type, the cable type, and the die-swaged type. How to use Technical Orders. How to use AN Standards.
(2) Inspect the turnbuckle.	Thread sizes. How to inspect the threads of the turnbuckle. How to inspect the turnbuckle for cracked barrels; holes not drilled concentric with outside of barrel; bent, warped, or mutilated shanks.
(3) Assemble the turnbuckle.	The shank should fit the barrel with a snug fit, but must be loose enough to turn by hand. Both ends must be screwed in the same number of threads.
(4) Assemble the turnbuckle with clevis pins or clevis bolts, and install cotter pins.	Cotter pin sizes.
(5) Adjust tension by turning the barrel in the proper direction with a turnbuckle wrench or a stiff wire inserted in the hole of the barrel.	How to use rigging data and tension charts. Do not use pliers to turn barrel. When the adjustment is completed, not more than three threads should be exposed.

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(6) Safety-wire the turnbuckle with the specified safety wire.	Wire sizes. How to thread the wire through the hole in the barrel and pull it toward one end and through the cable eye, or the forked end, or swaged terminal end. How to wrap the wire around the ends of the turnbuckle the specified number of turns. How to check for proper tension or control action before safety-wiring the turnbuckle.
(7) Inspect the whole assembly. Inspect the proper tension, alignment, cotter pins, safety wiring, and make any other check which should be made to insure a satisfactory job.	How the control system operates. Inspection standards regarding surface controls and rigging.

Notice that the information related to each operation is placed directly opposite it and separated from the information related to other operations. You can readily see the reason for this separation. The related information must be taught in connection with the operation it concerns if the trainee is to be interested in it. It would be undesirable to teach all the related information at the beginning of the lesson before you could tie it up with any operation. Other more detailed suggestions for making a teaching plan for the installation of turnbuckles are given in Chapter VIII. In that chapter, these operations and items of related information become teaching points that constitute the material of your lesson.

The trainee may know some of this information before the class period begins. Nevertheless, the items of related information on your sheet of job break-down should be complete so that you overlook nothing of importance in your lesson plan. For example, if all of your trainees have learned thread sizes in another training period, you need to include only a passing reference to the sizes or a swift review of them in the lesson. On the other hand, you should list only those items of related information that a trainee *must know,* and you must eliminate those interesting but unnecessary items which you could teach if you had unlimited time.

A complete lesson plan for installing an aircraft turnbuckle in the control system of a plane is shown in Chapter VIII.

Of course, the installation of a turnbuckle is a simple job suitable for beginning trainees. Its break-down into operations, however, follows exactly the same steps as those used in more complicated jobs. As the trainee progresses, you will need to break down jobs made up of a greater number of operations.

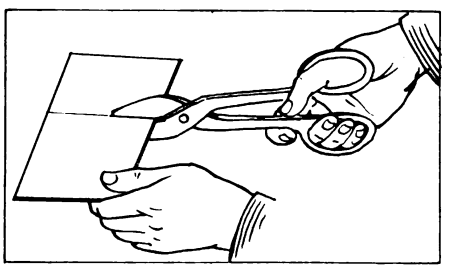
IV. JOB BREAK-DOWN—PREPARING MATERIAL FOR FLUSH RIVETING

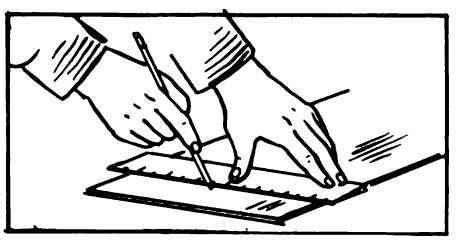
The following outline gives some of the operations and information used in preparing aircraft material for flush riveting. This more difficult job requires at least twenty-three operations when it is broken down completely.

JOB BREAK-DOWN SHEET

HOW TO PREPARE AIRCRAFT MATERIAL FOR FLUSH RIVETING

Operations **WHAT THE LEARNER MUST DO**	**Related Information** **WHAT THE LEARNER MUST KNOW**
In this column, list the step-by-step procedure which the workman goes through when performing the job.	In this column, list the information directly related to and necessary for the performance of the job.
(1) Select the stock, as indicated on the drawing.	How to recognize and select proper material for the job.
(2) Lay out flat plate, as indicated on the drawing.	How to read aircraft drawings. Principles involved in aircraft sheet metal lay-out.





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(3) Cut material.

Cut to within 1/32 in. of the outside line with the hand snips. Material should not be cut on the line, as a small allowance is necessary for finishing. If the shop is equipped with a bench shear, the flat sheet may be cut by this method instead of by hand with the snips.

The amount of material to be allowed for finishing to size.

Different ways in which material can be cut.

Safety precautions involved in the use of cutting tools.

(4) File to finished dimensions specified on the drawing.

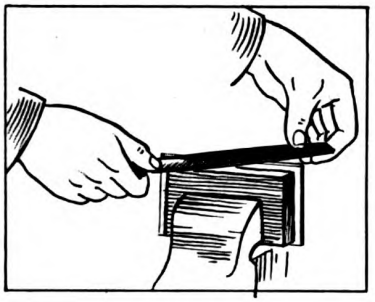
Remove burrs.

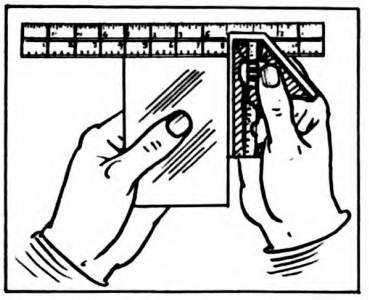
Types of files.

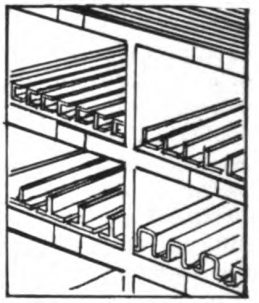
Chalk rubbed on file will help prevent clogging the teeth with aluminum.

Effect of scratches resulting from burrs on material. When gripping work in a bench vise for filing, it should be protected from being marred by use of soft jaws.

Importance of preserving protective coating on aircraft material.







(5) Check plate for squareness, flatness, and accuracy of dimensions.

Types of measuring tools.

(6) Select stringer stock.

Principles of airframe construction.

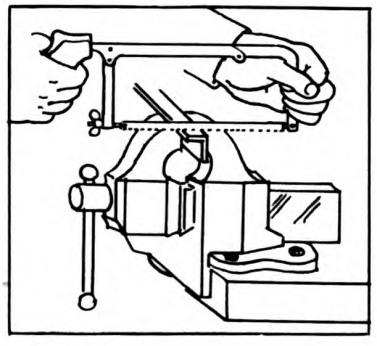
Types of stringers used. Stringers may be the extruded type or may be formed with a bending brake. Sheet aluminum alloy has a grain running through it, which can be determined by bending a sample. This fact is important when selecting, laying out, and cutting material for parts that are to be bent.

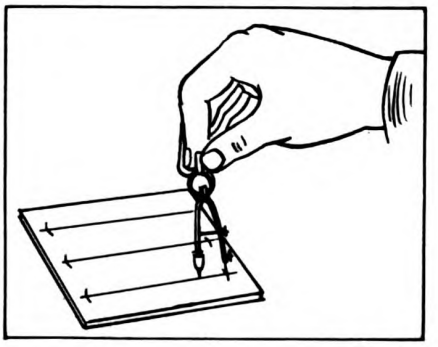
(7) Cut the stringer stock.

Types and sizes of hacksaw blades.

When sawing the extruded stringers, use soft removable jaws in the vise to prevent marring the material.

Assemble blade in the hacksaw so that the teeth point away from the operator. Use a blade of the "wave set" type.





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(8) Lay out rivet and stringer location on flat plate.

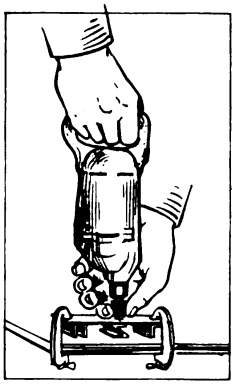
Principles of aircraft sheet metal lay-out.

How to use pencil compass. No scratch lines should appear on aluminum. A scriber should be used on outside lines only.

Rivet locations should not be center-punched.

(*Operations Nos. 9 to 21 omitted*)

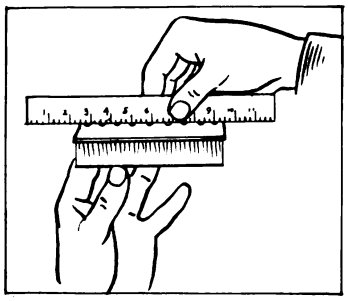
(22) Countersink the material, using a stop countersink with a portable drill motor.



Knowledge of the different ways in which material may be countersunk for flush riveting.

Safety precautions involved in countersinking.

Countersink a little way and remove the countersink from the hole to examine the work.



CAUTION:

Use goggles if countersinking overhead.

(23) Test the countersunk hole.

Examine the hole for roundness, evenness, and rivet fit.

Methods of inspection applied to flush-riveting procedures.

The rivet must be just flush with surface of the skin after riveting.

It is sometimes necessary to countersink a few thousandths of an inch deeper to allow for expansion during the riveting operation.

A steel rule laid across the rivet makes a good checking tool.

V. DETAILED ANALYSIS OF RELATED INFORMATION

In the preceding break-down, all of the related information was placed together in one column. One item had to do with the reading of drawings. Another dealt with safety or with measurement.

Sometimes you will find it desirable to separate these items into logical groups, putting all the safety items, for example, by themselves. This will enable you to check more easily to see if you have left out important items. It may also help you to organize your material better when you come to teach it.

The chart in figure 56 shows how the related material can be classified under the various headings. The job selected for this illustration is that of Measuring Cylinder Bores. The analysis is not complete, but it will give you an idea of what to include.

You can make a similar analysis chart of any job you may need to teach. Study figure 56 and the following instructions.

1. OPERATIONS

List the operations, step by step, in the sequence in which they would be performed.

2. TOOLS AND EQUIPMENT NEEDED

Opposite each operation, list the tools and equipment needed for that operation.

3. TRADE TERMS

List any trade terms that might be new to the trainee.

4. SAFETY PRECAUTIONS

List any special safety precautions which might help in avoiding accidents while performing the operation. To discover the safety precautions, take each operation and ask yourself what are the occupational dangers, the accidental dangers, dangers due to ignorance or to carelessness?

5. CALCULATIONS

In this column, list any calculations or trade mathematics that may be needed in order to perform the operation. These calculations might range from simple reading of measurements to fairly complex calculations.

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JOB BREAKDOWN CHART

JOB MEASURING CYLINDER BORE

OPERATIONS	TOOLS AND EQUIPMENT	TRADE TERMS	SAFETY PRECAUTIONS	CALCULATIONS	TRADE SCIENCE	READING OF DRAWINGS	TRADE JUDGEMENT
1- WIPE OUT CYLINDER BORE	CLEAN RAGS	BORE CHOKE BORE BARREL FLANGE RING WEAR SCORE OUT-OF-ROUND DIAL BLOCK ANTI-THRUST OVERSIZE HEAD END RING TRAVEL	HOLD CYLINDER FIRMLY WHEN MEASURING		EFECT OF HEAT ON CYLINDER BORE PRINCIPLES OF LUBRICATION WHY CHOKE BORE CYLINDERS ARE USED WHY CYLINDERS WEAR OUT-OF-ROUND		
2- INSPECT BORE FOR RING WEAR AND SCORE							KNOW INSPECTION STANDARDS
3- SELECT DIAL INDICATOR	DIAL INDICATOR						SELECTION OF PROPER TYPE OF INDICATOR-CHECK BEFORE USING
4- SET DIAL INDICATOR AT ZERO							
5- INSERT DIAL INDICATOR IN CYLINDER-NOTE READING							
6- MEASUR							

Figure 56—Job break-down chart—Measuring cylinder bore

6. TRADE SCIENCE

List here any applications of scientific principles which the trainee needs to know in connection with the operation. The expansion of metal with heat, the distribution of pressure in a hydraulics system, and the flow of electric current through a coil are examples.

7. READING OF DRAWINGS

Include in this column any special knowledge needed in the reading of drawings. This might include reading of schematic diagrams, assembly drawings, exploded drawings, and the like.

8. TRADE JUDGMENT

This column is for those items of trade information which one usually learns from contact with the job and might include such information as to how much material to allow for finish cuts, how much pressure to apply when tightening brass screws, or which tool to use when several types are satisfactory.

Column headings other than those shown on the chart might be used for breaking down the operations and their related information into smaller units. You should use only those headings which apply to the job. In filling out the columns, don't think that you have to fill up all the blank space. It may be that no calculations or reading of drawings are needed. List only the really necessary items. Keep in mind that some items might be "nice to know" but are really not necessary in doing the job.

VI. DEVELOPING THE COURSE OF INSTRUCTION

Up to this point you have been concerned with breaking down the occupation or the work job into smaller units. When you have finished this breakdown, you have available the raw material out of which you will build your course of instruction.

The way you approach the task of building the course depends upon a number of factors. You need to know the **aim or purpose** of the course. Is it a basic course which gives information and skills that are used in various advanced or specialized courses? Is it a course for training mechanics to maintain and repair many types of equipment? Is it a course which trains persons to perform very specialized operations? Most of the courses in the air depots are specialized courses, which prepare persons to do only very specialized jobs.

You need to know also whether the course is aimed to prepare persons for a type of work for which rigid procedures are specified in the Technical Orders, such as the overhaul of M-1 Generators; or whether the aim is to train persons to operate a specified type of machine, such as a milling machine, on which a variety of work is done. Sometimes the aim of the course may be broader and include the operation of several machines.

Again, the aim of the course may be that of up-grading or improving the skills of workers who already have had considerable experience, or of instructing them in some new procedure, or of increasing their range of technical knowledge. Whatever the aim of the course, you should understand definitely what is wanted. Otherwise, you may be shooting in the dark when you attempt to get together the material which is to be included in the course.

A second important item you need to know is the **background and abilities of the trainees** for whom the course is intended. It is one thing to build a course of instruction for persons who have had preliminary experience and training. It is quite a different matter to build a course for persons who have never been inside a shop or an air depot.

A third item of importance is the **length** of the course. Will the course extend over a period of six months, or ninety days, or one week? Most courses in the depots are limited to ninety days or less. If you do not take the time element into account, you may include so much in the course that you will never be able to cover it in the time you have available. Or, you may include too little content and run out of material before the course is completed.

There are many other items that you should take into account. What kind of equipment will you have

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to work with? To what degree of skill do your enrollees have to be trained? Will your course cover only the shop work or will it cover the related technical information as well? Will the course be given in a separate training shop or classroom, or will it be given "on the job"? These are a few of the items you will consider.

After you have gotten a good idea of the purpose of the course, the kind of trainees, the time available, and the like, you are ready to go ahead with actually getting together the content you will want to include. How do you go about this? If the course deals with those kinds of work in which specified equipment is overhauled, and for which definite procedures are available in the Technical Orders, you do not have much choice as to what content to use and how to arrange it. You have to follow the procedures, in their proper sequences, as laid down in the Technical Orders. In general, these procedures include disassembly, cleaning, inspection, repair or replacement of parts, assembly, and testing. Your course of instruction would thus include these procedures in their proper order.

But you may have to choose which particular *types of equipment* you use for your course, if there are several types in use which are much alike. If you are training Generator Overhaul Specialists, you need not give training on every type of generator used in aircraft. Instead, you select typical generators and instruct your trainees on them. If these generators are selected carefully so as to include samples of the different types, and if your learners are trained to use the Technical Orders, they will usually be able to overhaul other generators without too much trouble.

Similarly, if you were training a milling machine operator, you cannot include in your course every job that might be done on a milling machine. In this case, you will need to select *type jobs* which cover the operations commonly used. It is not easy to select these type jobs. There should be enough of them to provide practice on all the different operations, with enough repetition so that the trainee will really develop skill. They need to be varied in difficulty, with easy jobs for the beginner and harder jobs as he gets farther along in the course.

JOB CHECK CHART
AIRCRAFT SHEET METAL

JOBS / OPERATIONS →	Using Measuring Tools	Selecting Stock	Using Hacksaw	Using Snips	Using Bench Shears	Using Floor Shears	Using Layout Tools	Filing	Drilling	Riveting	Countersinking
PATCH PLATE	✓	✓		✓			✓	✓	✓	✓	
BAFFLE PLATE	✓	✓		✓	✓		✓	✓	✓		
NOSE BULKHEAD	✓	✓		✓			✓	✓	✓		
SHEAR BEAM	✓	✓	✓			✓	✓	✓			
FRAME SPLICE	✓	✓		✓			✓	✓			

Figure 57—Job check chart—Aircraft sheet metal

In selecting the type jobs you may find that a Check Chart similar to that shown in Figure 57 will be useful. Along the top of the chart are listed the various operations the trainee needs to learn. In the column at the left are listed a number of jobs which you think might be used as type jobs to be included in the course of instruction. The Check Chart is used to help you check these jobs that you think might be used, against the list of operations the trainee needs to learn. In using the chart, you place a check mark under each operation that is included in the particular job. After you have checked a number of jobs which seem to be worth including in your course, you can look down the column under each operation and see how many times that operation has been included in the list of jobs you have tentatively selected. You may find that some operations are not included in any of the jobs. In this case, you will need to add more jobs which include these operations. You may find that certain operations are repeated too many times, and this may indicate the need for throwing out certain jobs and substituting others. If the trainee is to develop skill, many of the operations need to be repeated several times in the course. In your final list of type jobs, you should make sure that all these operations are covered and are repeated as often as may be necessary.

VII. ARRANGING CONTENT IN INSTRUCTIONAL ORDER

Your completed course of instruction should have the various jobs arranged in proper order, with the easier jobs first. Good instruction requires a course in which the difficulty of the jobs increases as the course proceeds. In an ideal situation each job the trainee does is a little harder than the previous one. Usually, it is not possible to get a uniform progression from easy to difficult jobs; but we try to get as near to this as possible.

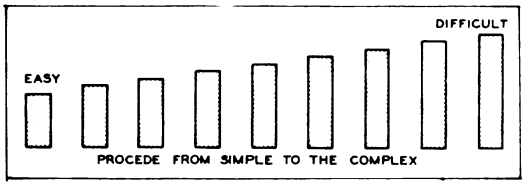

Figure 58—Desirable learning sequence

How do we determine whether a job is easy or hard for a trainee? One way would be to try the jobs out on a number of trainees and observe the difficulties they encounter. This is perhaps the surest way to find out the trouble they are likely to run into. But we can check the various jobs with respect to certain items which have a bearing on the difficulty of performance and get some idea of which jobs are easier or harder. Some of these items are as follows:

1. ACCURACY REQUIRED

It is easier to finish a part to an accuracy of one-sixteenth of an inch than to one ten-thousandth.

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2. NUMBER OF OPERATIONS REQUIRED

A job requiring many operations is usually more difficult for a learner than one with few operations.

3. SPEED REQUIRED

The job that requires completion in a very short time is usually harder than one which can be performed at a slower rate.

4. COMPLEXITY OF THE JOB

If the trainee has to do several things at one time, or keep several things in mind at one time, it is more difficult for him to learn how to do the job than if he had to think about fewer items.

5. NUMBER OF TOOLS OR AMOUNT OF EQUIPMENT NEEDED

The job requiring few tools and little equipment is usually the easier to learn.

6. SAFETY PRECAUTIONS (FEAR)

Jobs on which the learner is afraid, or in which there is considerable hazard, are usually harder to learn than those which have few hazards.

7. TECHNICAL INFORMATION NEEDED

Jobs which require the trainee to use considerable technical information are usually harder to learn than those where little technical information is needed.

These items which we take into consideration when determining the difficulty of a job are often called "difficulty factors" or "progression factors." Figure 59 shows a progression factor chart, listing the seven items noted above. There may be other items which need to be considered in certain jobs. In this chart are shown graphs for three different jobs, with the degree of difficulty for each of the seven items. The graph for Job No. 1 is near the bottom of each of the columns, indicating that it is a relatively easy job, suitable for a beginner. The graph for Job No. 2 shows that quite a high degree of ability is required with respect to accuracy, use of many tools, safety precautions, and technical information. This job evidently is not a good job for a beginner. The graph for Job No. 3, with high values on all items, shows this is an advanced job to be taught in the latter part of the course.

When it is possible for you to do so, each job you propose to include in your course should be checked in a manner similar to that shown above. Then the various jobs can be arranged in the order of their learning difficulties and taught in that order, if possible.

For courses of instruction which have to do with overhaul of equipment, it is necessary that certain operations be performed in a definite order, such as disassembly, cleaning, inspection, repair or replacement, etc. The instructor has to follow the order of the operations specified in the Technical Order. Sometimes the hardest operation may be the very first one.

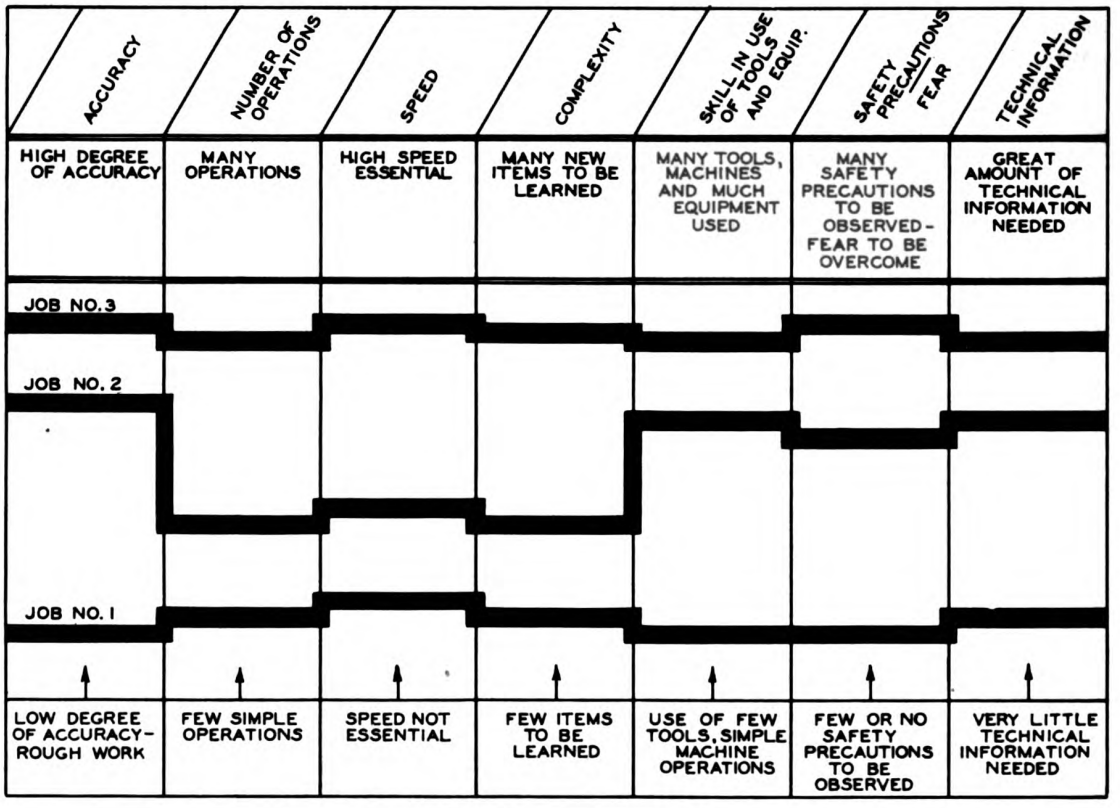

Figure 59—Progression factor chart

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Usually, the various operations do not follow a regular order from easy ones to hard ones but are mixed up as shown in Figure 60.

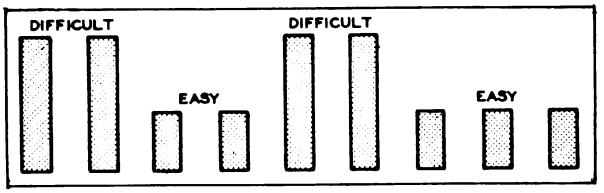

Figure 60—Typical production sequence

When instructing a trainee in performing a job of this type, it may be desirable for the instructor to do part of the work himself and have the trainee do part of it. The instructor would perform the hard operations and would have the trainee do the easier ones, the first time through. (See figure 61.)

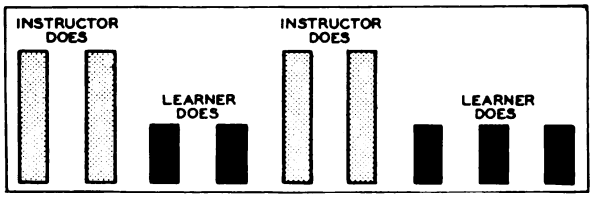

Figure 61—Training sequence—First time through

After the learner has performed the easier operations and has seen how the instructor does the harder operations, he tries these as well. Finally, he is able to perform all of the operations himself. (See figure 62.)

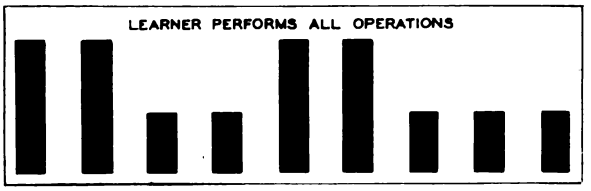

Figure 62—Training sequence—Later stage

If your course deals with related technical information instead of shop operations, you will have a somewhat wider choice of material. One difficulty here is in knowing where to stop, for the tendency of most instructors is to include too much material. Limit the content of your course to those things the trainee really needs to know. Leave the other items until after the war.

The procedure to follow in organizing a course of instruction in related technical information is much the same as that used for courses in shop work. From your analysis, select those items dealing with applied science, applied mathematics, reading of drawings, etc., which the trainee needs to know. Arrange these items in convenient groups for teaching purposes. In so far as possible, place them in good instructional order, with the easier material early in the course. In your instruction, tie the related information as closely to the job or the operation as possible.

Frequently, the courses of instruction are worked out by the supervisor or administrator of the training program and placed in the hands of the instructor; but very often, new or different courses are needed to meet special situations, and the instructor must develop his own course.

Air Service Command now has available many course outlines for the training of specialists in the air depots. The following outline of one of these courses, for the training of Aircraft Electrical Systems Repair Specialists, shows both the shop instruction and the related information.

AIRCRAFT ELECTRICAL SYSTEMS REPAIR SPECIALISTS

Outline of Training Course

1. PURPOSE.

To train specialists in repair of typical items of aircraft electrical equipment in the shortest possible time.

2. DURATION.

Only sufficient time will be given each trainee to complete in a satisfactory manner the contents of this course. Time consumed, therefore, will depend on each trainee's ability to master the work.

Approximate time for this course will be 9 weeks, including time spent in production work.

3. PROGRAM.

This instruction course is selected from the field of Aircraft Electrical Work. This is not a broad basic or orientation course but is a specialist course. It covers only repair work on typical electrical equipment. Trainees will be taught only the skills and understandings that are essentially needed by them to perform this work satisfactorily.

During the latter part of this course the trainees will be required to repair several pieces of electrical equipment drawn from the repair line, which must stand periodic and final inspections by Engineering Department inspectors, as well as by Training Department inspectors.

Instructions will be given in necessary related subjects and in shop training and production work, using texts as indicated.

4. GENERAL OUTLINE OF INSTRUCTION.

RELATED INFORMATION

a. Orientation.

(1) Explanation of course, its intent and purpose.
(2) Depot and/or school organization.
(3) Depot and/or school regulations.
(4) Technical Orders and their uses.
(5) Air Corps Forms and their uses.

(Texts: A.S.C. Basic Manual, Individual Depot Supplement.)

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b. Technical Information.

(1) Safety practice and procedures.

(2) Electrical fundamentals.

(3) Principles of the electric motor.

(4) Theory, construction features, and principles of operation of the various types of electrical equipment used on aircraft.

(5) Measurements involved in installation of electrical wiring and equipment.

(6) Theory of magnetism.

(7) Proper selection, care, and use of tools and equipment.

(8) Wire coding as used in aircraft electrical work.

(Texts: A.S.C. Instructional Guide, Technical Manuals, TM 1-410 Airplane Structures, TM 1-406 Aircraft Electrical Systems, TM 1-455 Electrical Fundamentals.)

c. Reading Air Corps Drawings.

(1) Kinds and uses of drawings.

(2) Conventions used on drawings.

(3) Study of Air Corps Drawings as used in electrical repair work.

(4) Study of charts, sketches, and diagrams as used in electrical repair work.

(Text: A.S.C. Informational Guide.*)*

SHOP TRAINING

(Texts: Technical Orders, Trainee Work Guide.)

Technical Orders for the particular electrical items to be repaired are to be used.

Job 1. Repair ammunition round counters.

2. Repair lamp motors.

3. Repair transformer.

4. Repair flexible conduit.

5. Repair fuel quantity gage and warning signal.

6. Repair voltage regulators and relays.

7. Do continuity testing.

8. Do continuity testing with meter.

9. Repair lighting system.

10. Repair solenoids, all types.

11. Repair flap control motors and systems.

12. Repair main distribution box.

13. Repair propeller relays and switches.

14. Repair propeller brushes.

15. Repair starter circuits.

16. Repair generator circuits.

17. Repair dynamotors.

18. Repair inverters.

19. Repair landing gear systems and motors.

20. Repair armament controls.

21. Repair control panel (if trainee progress and ability permits).

22. Repair fluorescent lamps.

23. Repair landing lights.

QUESTIONS

(1) What is the purpose of *job break-down?*

(2) What is meant by *production sequence? instructional sequence?*

(3) What factors would you take into account in determining whether a job was hard or easy for a beginning trainee?

(4) What is meant by a Job Check Chart? What is its purpose?

(5) Draw up a job break-down chart for some job in your field of work, showing the operations and the related technical material.

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Chapter 8

PLANNING FOR INSTRUCTION

The instructor makes plans for the day and for each instructional period.

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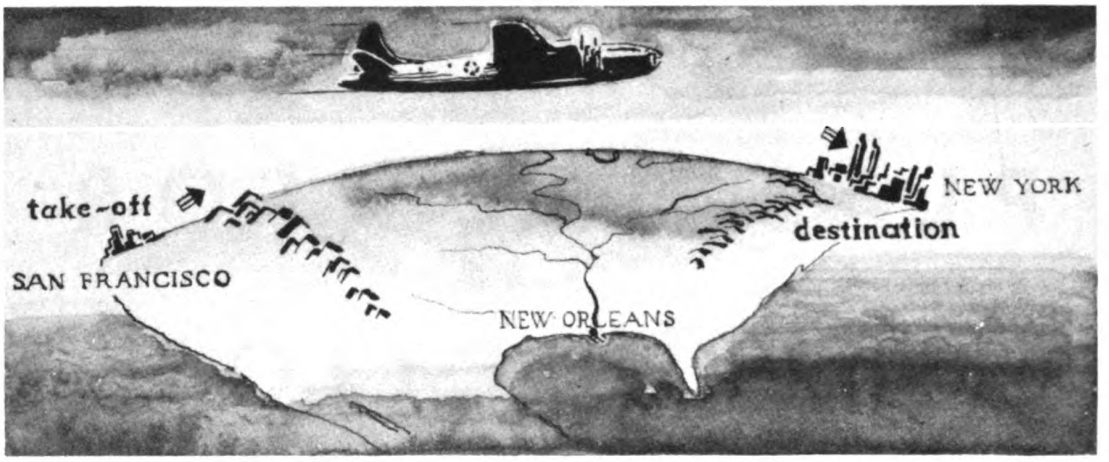

Figure 63—A planned flight

PLANNING FOR INSTRUCTION

Just as a pilot has careful plans for his flight, a good instructor plans thoughtfully for each class session. The pilot must know his destination and route before the take-off. He charts his course to avoid unfavorable weather and difficult terrain, and plans to take advantage of favorable winds.

I. KNOW YOUR AIM AND YOUR METHOD

In making your plans for instruction, you also need to know the destination or aim of each class session before it begins. You may not always follow the same route, because trainees in one class may differ from those in another. Besides, your procedure will vary according to the material of your instruction and according to the teaching situation. For example, if you wish to increase a trainee's skill in an operation, your procedure must include time for him to practice the operation. On the other hand, if you wish experienced trainees to work out a problem in shop management, you might plan to use a conference.

II. KNOW THE OPERATIONS AND RELATED INFORMATION

Think back to the job of the pilot for a moment. He must have information about engines, instruments, principles of flight, and other subjects before he is allowed to fly; but he must also learn how to perform the operations necessary for flying. In other words, he must *know* certain things and he must *do* certain things, if he is to reach his destination. As an instructor, you, too, must know certain things and do certain things. This "know" and "do" combination must be part of your trainee course.

Since your trainees also need to know as well as to do certain things, you are wise if you think out your lesson in these terms. A list of the operations in the order in which the trainee does them will help you arrange the work you expect him to do. Also, you need a list of things you expect him to know. These operations and items of information are the teaching points of the lesson. Some of these teaching points are of a special kind, called *key points*. Whenever you find a point which may prevent a trainee from making a mistake, you have noticed a key point.

Select only those teaching points that relate directly to your objective. Distinguish sharply between the things the trainee *must know*, the things it would be *desirable* for him to know, and the things it would be *nice* for him to know. For intensive training, the teaching points should be limited to what he *must know*.

Just as a plane maintains an altitude suited to con-

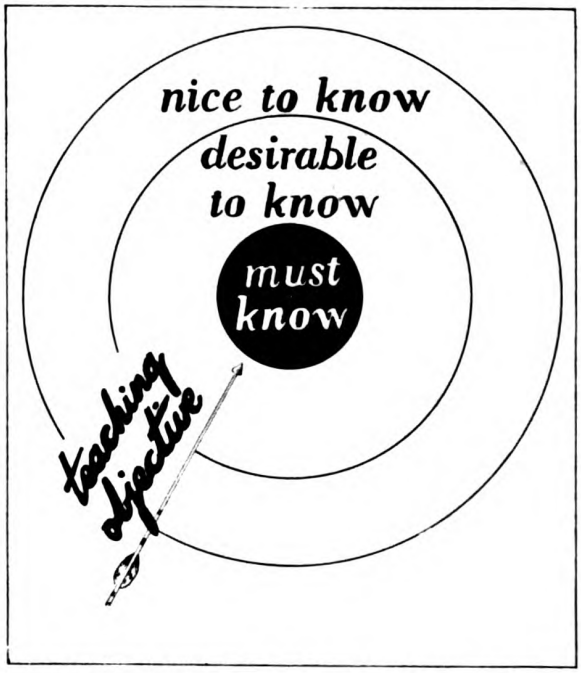

Figure 64—Teach what the trainee must know

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ditions of the land and air, your instruction about operations and teaching points should be at the proper level for your trainees. If you are too far above their level in your explanations, or if you go over the

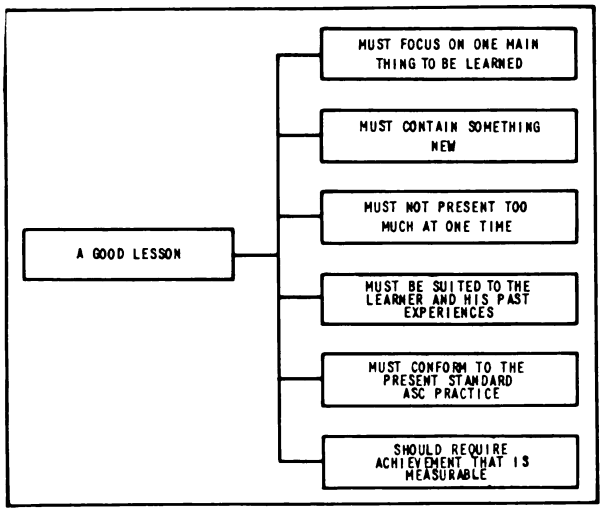

Figure 65—Requirements of a good lesson

points too rapidly, they will not grasp your meaning.

Also, it is important that your "take-off" at the beginning of the lesson be smooth and well-planned. It should arouse in the trainee a sense of anticipation and a desire to learn, and it should be close enough to familiar ground for him to feel at home.

A well-balanced lesson must meet certain other requirements, as indicated in figure 65.

III. PLAN THE LESSON

How can you meet all of these requirements? The answer is that lessons must be planned. A good lesson does not happen accidentally. Good instructors plan their lessons. Some of them write detailed plans; others, particularly those who have taught for some years, write the main points and plan the other points in their heads. Until you have had considerable experience, it is a good idea for you to plan your work in detail. An outline for a simple plan which contains the necessary points follows:

OUTLINE FOR A LESSON PLAN

COURSE_____ DAY____ HOUR_____

1. **LESSON TITLE:**
2. **OBJECTIVE:**
3. **TRAINING SITUATION:**
   - *a.* **Special Characteristics of Subject Matter.**
   - *b.* **Problems of Students.**
   - *c.* **Time Available.**
   - *d.* **Equipment and Teaching Aids.**
   - *e.* **Local Conditions and Obstacles.**
4. **WARM-UP:** (Give introductory material which will prepare the trainee.)
5. **PRESENTATION:** (Tell how to present the new material. List operations, information, and safety precautions.)

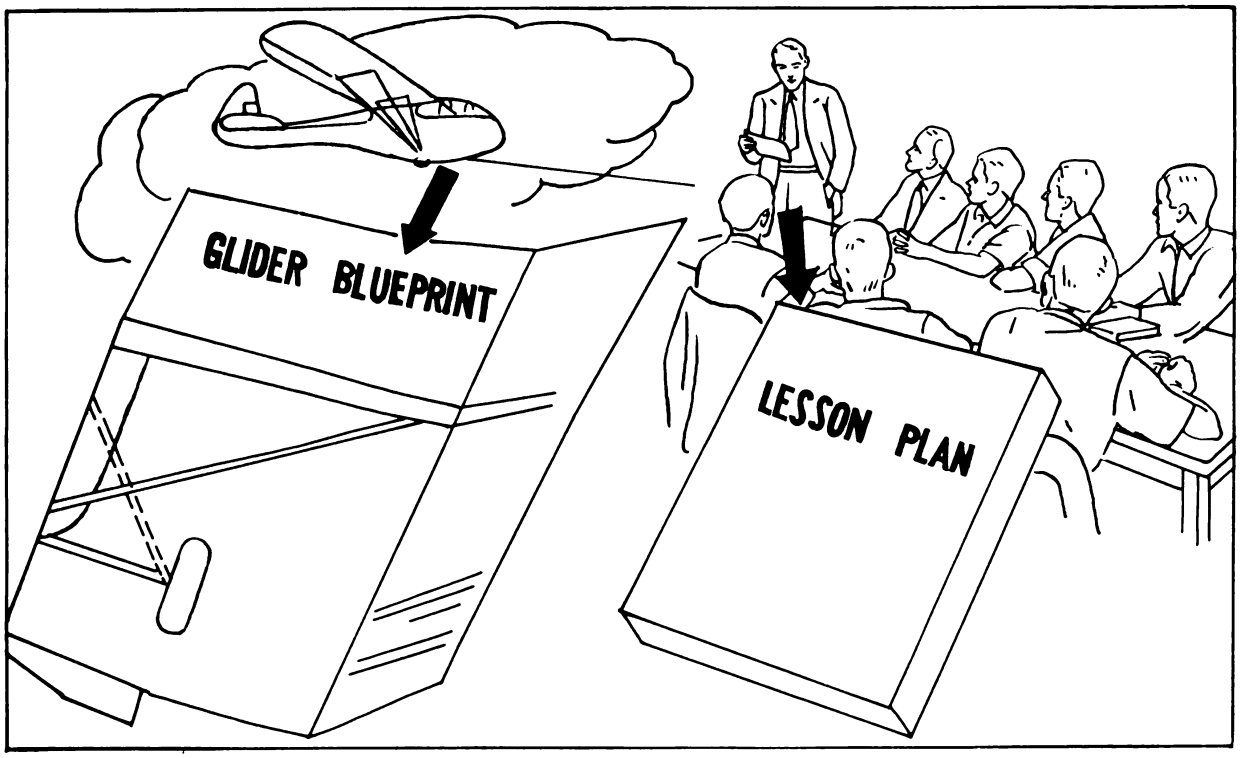

Figure 66—A lesson plan is a blueprint of instruction

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6. APPLICATION: (Provide for trainee use. Plan for individual differences. Note safety factors.)

7. TESTING: (State how to evaluate trainees' work.)

8. SUMMARY: (Summarize the important points.)

9. ASSIGNMENT FOR NEXT LESSON.

Such a plan is as necessary for good instruction as a blueprint is for production. The blueprint gives dimensions, materials, and specific directions for the making of a product; likewise, your lesson plan is a practical working guide which summarizes materials, procedure, and methods you expect to use. You would not think of building a glider without first making a blueprint. You should use the same care in making out your plan for a class session; for instructing without a plan is like building a glider without a blueprint.

LESSON PLAN—INSTALLING A DECALCOMANIA

This outline for a *lesson plan* may be used for almost any kind of a lesson. Suppose you are an instructor in the paint shop, and you have reached a point where you are going to give your group a lesson on installing a *decalcomania.* In making your plan for this lesson, your first job is to make a list of the various things you want to cover in the lesson, including both operations and related information. Your list would probably include items similar to the following:

(1) Clean the surface of the plane with a cloth dampened with wax and grease remover.

(2) Clean the soapstone from the decal with another cloth.

(3) Apply size to the decal; and if the surface is old, size the surface also. (Size is a thin glue which is used to give greater adhesion to smooth surfaces.)

(4) Allow sizing to become "tacky" or sticky.

(5) Sponge the sizing with a damp sponge.

(6) Place the decal in position, and apply pressure to hold it there.

(7) Roll out the air bubbles. (A small rubber hand roller is used for this operation.)

(8) Knife out any remaining bubbles. Use a putty knife with a wide blade.

(9) Remove the heavy paper.

(10) Wet the tissue with a sponge and remove it.

(11) Remove the excess size around the edges with a rag dampened with thinner, and wipe the edges with a damp sponge.

(12) Allow the decal to dry overnight.

(13) Brush on clear airplane dope.

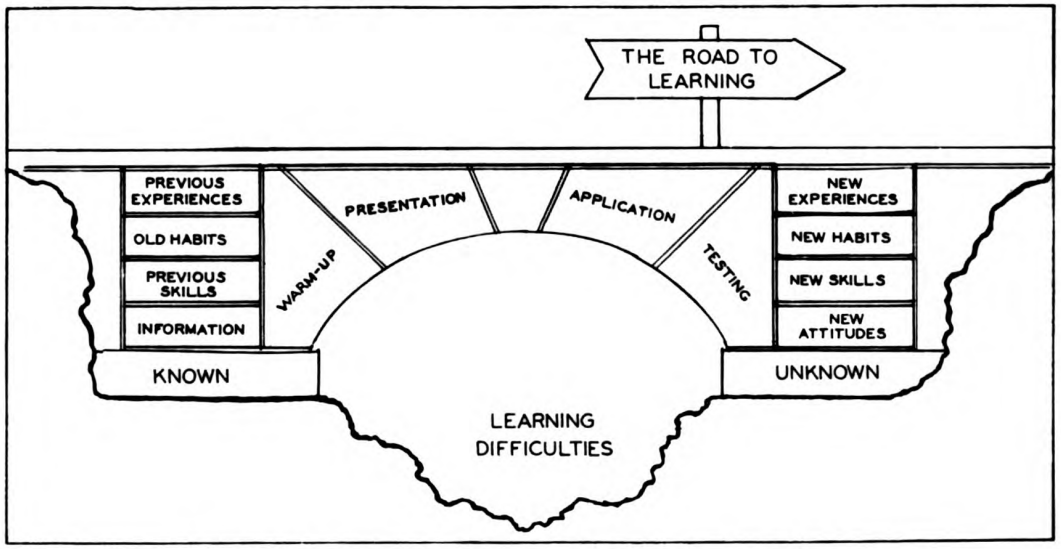

Figure 67—A planned lesson as a bridge over learning difficulties

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When you have made out the list of items you expect to include in the lesson and have checked it to see that you have not left out important items or included items that are not really necessary, you are ready to go on to that part of the lesson plan which deals with how you will handle the lesson. Each lesson plan should include both **what** you will teach, and **how** you will teach it.

Now you are ready to think about the steps in your lesson—warm-up, presentation, application, testing. To get the trainee ready to learn, you want to find an approach that will arouse his interest and will tie the new knowledge to something he already knows. Your job as an instructor is to build upon his foundation of known facts and previous experiences. Nothing new can be taught without proceeding from the known to the unknown.

Perhaps the trainees are interested in the meaning of plane insignia, and they may have put decals on furniture or walls in their own homes. Then the lesson must be presented in a clear and orderly fashion. Probably you will plan to use the demonstration method and explain the steps as you go along. You could then give the trainees a chance to apply decals while you watch and make suggestions. Finally, you could arrange some simple way of testing their skill in applying decals.

The next step in planning your lesson takes you to the materials you need for instruction. In this particular lesson, your plan should include a list of the materials so that you can easily collect them before the opening of class. If you need any instructional aids, such as pictures of planes with various insignia, include them in this list so that you would not forget them at the last minute.

All of this planning for your class period in the paint shop may result in a plan something like the one which follows.

LESSON PLAN

COURSE—Aircraft Painting—**DAY** Mon.-**HOUR** 8-10

1. **Lesson Title:** Installing a Fuselage Decal.
2. **Objective:** To teach the trainee to apply decal insignia to the fuselage of an airplane.
3. **Training Situation:**

a. **Special Characteristics of Subject Matter:**

See Information Sheets of Unit Course in Aircraft Painting by the Utah State Board of Vocational Education.

b. **Problems of Students:**

(Smith and Jones), (Doe and Brown), (Wright and Quinn) and (Hughes and Cobb) should work together. (Quinn is short; have him get 2-foot platform.)

c. **Time Available:**—2 hours.

d. **Equipment and Teaching Aids:**

5 decals	2 pcs. plywood, 2 x 2 ft
1 pt wax and grease remover	1 qt thinner
1 water can	1 brush
1 sponge	1 roller
1 qt size	1 putty knife
	1 qt clear dope

e. **Local Conditions and Obstacles:**

Only one fuselage is available for decals.

4. **Warm-Up:** (Give introductory material which will prepare the trainee.)

Questions:

(1) What identification markings are used on American Army planes?

(2) Why was the design of the identification marking changed?

(3) Are these markings painted on the planes?

(4) What is meant by a *decalcomania?*

5. **Presentation:** (Tell how to present the new material. List operations, information, and safety precautions.)

a. Explain how insignia may be applied to the plane by means of transfer patterns (or decals).

b. Demonstrate the procedure as follows:

Procedure:

(1) Clean the surface with a rag dampened with wax and grease remover. A decal will not adhere to a waxy or greasy surface.

(2) Clean the soapstone from the decal with a rag. Any dust or dirt either on the decal or the fuselage may cause trouble later on.

(3) Apply size to the decal; and if the surface is old, apply size to the surface also.

What kinds of size may be used?

(4) Allow the sizing to become tacky or sticky.

The decal will not adhere if the sizing is wet.

(5) Sponge the sizing with a damp sponge.

Key Point: It is sometimes necessary to move the decal slightly after it is first applied.

(6) Place the decal in position, and apply pressure to hold it.

Using the flat of the hand, apply pressure in several places until the decal adheres to the fuselage.

(7) Roll out the air bubbles.

Air bubbles must be excluded if the job is to have permanence.

(8) Knife out any remaining bubbles.

Use a putty knife with a wide blade, and work outward from the center.

(9) Remove the heavy paper covering the decal.

Start at one edge and carefully pull it off.

(10) Wet the tissue with a sponge, and remove it.

The tissue serves as an added protection to the design.

(11) Remove the excess size around the edges with a rag dampened with thinner, and wipe the edges dry with a damp sponge.

A smooth finished surface is desired, as rough edges increase wind resistance.

(12) Allow the decal to dry overnight.

To insure final protection, the insignia must be dry before it is painted.

(13) Brush on clear airplane dope.

This is the final protective coat.

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NOTE

This operation must be performed at a later date.

6. **Application:** (Provide for trainee use. Plan for individual differences. Note safety factors.)

Since only one fuselage is available, two pairs of trainees will apply decals to the two plywood boards, which are first fastened to a bench in a vertical position.

Watch each trainee as he applies a decal, and correct his mistakes.

7. **Testing:** (State how to evaluate trainees' work.)

a. Inspect for position.

b. Inspect for air bubbles.

c. Inspect for excess size.

d. Use an oral or a written quiz to gage the trainees' understanding of the lesson.

e. Criticize constructively to help the trainee improve his performance.

8. **Summary:** (Summarize the important points.)

9. **Assignment for next lesson:**

TOMORROW IN CLASS.—How to apply the final coat of clear dope, which serves as a protective coat and helps hold the decal in place.

NEXT JOB TO BE DONE.—Making stencils for other letter insignia.

STUDY AT HOME.—Job Sheets Nos. 11 and 12 of Aircraft Painting and Doping. Be sure to know the sizes of the letters and the general method for making the stencils before you come to class.

LESSON PLAN—INSTALLING A TURNBUCKLE

As another example, let us devise a lesson plan for teaching the operations and information you would use in installing a turnbuckle in an aircraft control system. You remember that a job break-down of this material was worked out in detail in Chapter VII. How can this material be used for building a lesson plan?

Once again, your first step would be to decide on the title and objective of the lesson. Be sure that the title states exactly what you propose to do in the lesson, and that the objective for the trainees is reasonable for persons of their ability and background. Then you would go on with the other parts of the lesson plan, including the Training Situation, Warm-Up, etc. The completed plan might read as follows:

LESSON PLAN

COURSE—Aero Repair—**DAY**—Tues.—**HOUR**—8-10

1. **Lesson Title:** Installing an Aircraft Turnbuckle in a Control Cable.

2. **Objective:** To teach the trainee how to install aircraft turnbuckles in the control system of an airplane.

3. **Training Situation:**

a. **Special Characteristics of Subject Matter:** Accuracy of this procedure was checked by the cable specialist.

b. **Problems of Students:** None.

c. **Time Available:** Two hours.

d. **Equipment and Teaching Aids:**

One turnbuckle with cable eye and forked pin eye.

One turnbuckle with cable eye and plain eye.

One turnbuckle with die-swaged cable and forked pin eye.

One airplane control assembly.

NOTE

Control assembly is used to give trainees practice in installing turnbuckles.

e. **Local Conditions and Obstacles:** Everything satisfactory.

4. **Warm-Up:** (Give introductory material which will prepare the trainee.)

Questions:

a. Why would a wire clothes line be slack on a hot day but fairly taut on a cold day?

b. How does temperature change affect the cables operating the controls of a plane?

c. How would prolonged use affect the tension on the control cables?

5. **Presentation:** (Tell how to present the new material. List operations, information, and safety precautions.)

a. Turnbuckles are used in the control cables of a plane to keep a tension on the controls so that they operate freely and without excess play.

b. Procure a turnbuckle of the type required for the installation.

Key Point: Demonstrate the construction by showing that turnbuckles have a right-hand thread on one end, and a left-hand thread on the other.

Show by demonstration that turnbuckles are obtainable with different types of ends; the forked type, the pin type, the cable type, and the die-swaged type. Explain how to use Technical Orders and AN Standards for this installation.

c. Inspect the threads of the turnbuckle.

Explain that turnbuckles use the National Fine Thread.

d. Assemble the turnbuckle.

Inspect the barrel for cracks and eccentric holes. Inspect the shanks to see if they are warped or mutilated. The shank should fit the barrel with a snug fit but must be loose enough to turn by hand.

Key Point: Screw in the ends so that each will have the same number of threads inside the barrel.

e. Assemble the turnbuckle with clevis pins or clevis bolts, and install cotter pins.

Cotter pin sizes are given in terms of the diameter and the length of the pin. A 3/32- x 1-inch pin means one which has a diameter of 3 32 inch and a length of 1 inch.

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f. Adjust the tension by turning the barrel in the proper direction with a turnbuckle wrench or a stiff wire inserted in the hole of the barrel.

Explain the use of rigging data and tension charts. Do not use pliers to turn barrel. When the adjustment is complete, not more than three threads should be exposed.

g. Safety-wire the turnbuckle with the specified safety wire.

Demonstrate how to check for the proper tension, and how to thread and wrap the safety wire through and around the turnbuckle.

h. Inspect the whole assembly.

Explain how the control system operates, and give the standards of inspection which must be observed.

6. **Application:** (Provide for trainee use. Plan for individual differences. Note safety factors.)

Watch the trainee while he installs a turnbuckle on the control system of a plane. Check his procedure, and correct and explain any mistakes he may make.

7. **Testing:** (State how to evaluate trainees' work.) Check the following:

a. Test the installation for proper tension.

b. Test the installation for alignment.

c. Inspect the installation for cotter pins.

d. Inspect the safety wiring.

8. **Summary:** (Summarize the important points.) List the operations.

9. **Assignment for next lesson:**

NEXT JOB TO BE LEARNED: Installing aircraft control cables.

PREPARATION OUTSIDE CLASS: Read pp. 121-128 in Norcross and Quinn, *The Aviation Mechanic.* Review procedure of installing turnbuckles.

WHAT TO EXPECT IN CLASS: You will have a chance to replace entire cables in a control system. Replacement of these cables will give you more experience with turnbuckles.

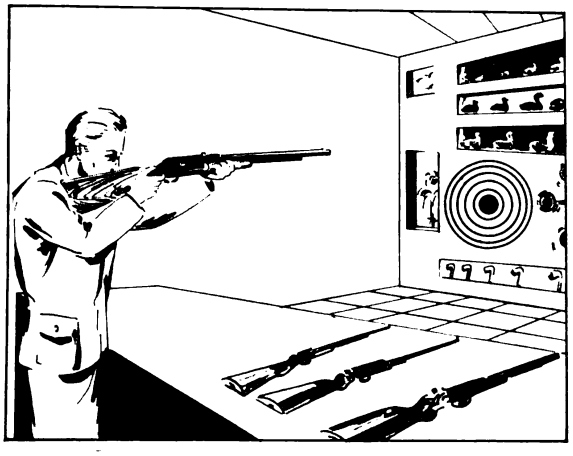

Figure 68—Know what you are shooting at

IV. INSPECT YOUR LESSON PLAN

Every product for use by the armed services must be inspected according to government standards before it is accepted. If your lesson plan were inspected before use in the depot, would it be accepted? Here are some of the standards by which you may judge your plan:

(1) Does your plan have a *definite objective?* Do you know what you are shooting at?

(2) Does the plan use the *right tools* for the job? If visual aids are needed, does the plan select the best ones for your purpose?

(3) Does the plan provide *lists* so that you can easily check apparatus or equipment and materials before the class session?

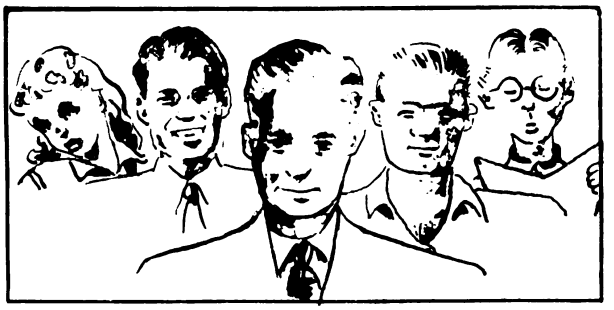

Figure 69—Provide for individual differences

(4) Does the plan provide for *individual differences?*

(5) Does the plan provide work for every member of the class?

(6) Does the plan arrange the work according to the difficulty of the material? Have you started with something familiar or easy and worked up to the difficult operation or principle?

(7) Are the parts of the material in clear and reasonable order?

(8) Is any part of the lesson too long to maintain the interest of the trainees?

(9) Can your visual aids be covered except when they are in actual use? They should not distract the trainees.

(10) Does the plan provide a large number of checking points of student progress?

(11) Does the plan provide a definite and clearly organized assignment for the next lesson? Are you sure that the assignment cannot be misunderstood?

(12) Are your questions thought-provoking?

(13) Have you used interesting comparisons to stimulate the interest and increase the knowledge of your trainees?

Each lesson you teach should be carefully planned. A good instructor never reaches the point of perfection where planning is not necessary. As you become more familiar with the teaching procedure, your lesson plans may be abbreviated. Nevertheless, the more carefully you plan, the more your trainees are likely to learn.

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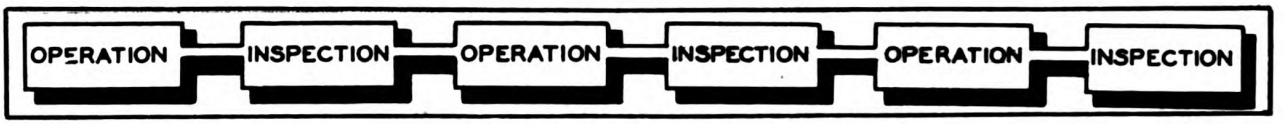

Figure 70—Plan for frequent checking points

V. PREPARE A SCHEDULE OF LESSON PLANS

The good instructor not only plans each individual lesson; he prepares a schedule of these lesson plans so that he knows just what he will teach each day of the week and each period of the day. You will probably want to make up such a schedule for the groups you are instructing.

Suppose you are an instructor in the paint shop and that you have four groups of trainees each day; one group from eight o'clock until ten, the next group of trainees from ten until noon, the third from one until three, and the fourth from three until five. You might plan a schedule like this:

Figure 71—Use interesting comparisons

GROUP	I	II	III	IV
TIME	8-10	10-12	1-3	3-5
LESSON TITLE	Installing a decalcomania	Painting ornamental stripes	Painting the identification numbers	Removing the old finish
OBJECTIVE	To teach trainees to apply decal insignia to the fuselage of an airplane	To have trainees practice painting of ornamental stripes	To have trainees practice painting identification numbers	To teach how to prepare the surface for painting

In addition to making plans for one day, you will want to look ahead and plan your work for several days. Take into account the time you need to secure the materials and equipment for your lesson. Also, arrange to reserve a certain shop or classroom if either is necessary for the lesson. Remember that good planning means effective instruction.

QUESTIONS

(1) Why is it desirable to include a considerable amount of detail in your first lesson plans?

(2) If you are not sure how your material will fit the time available for the lesson, is it better to include more material in your plan than you will probably use, or to include a minimum amount and find something else to do to fill in the time if the material runs out?

(3) What are the standards by which we can rate a lesson plan?

(4) Make a complete lesson plan for one session, using the outline given in this chapter.

(5) Criticize your plan in the light of the standards you have set up in answer to *question 3.*

(6) What ways can you suggest to improve your ability in lesson planning?

(7) How could you check a lesson plan to determine whether or not the lesson is too long?

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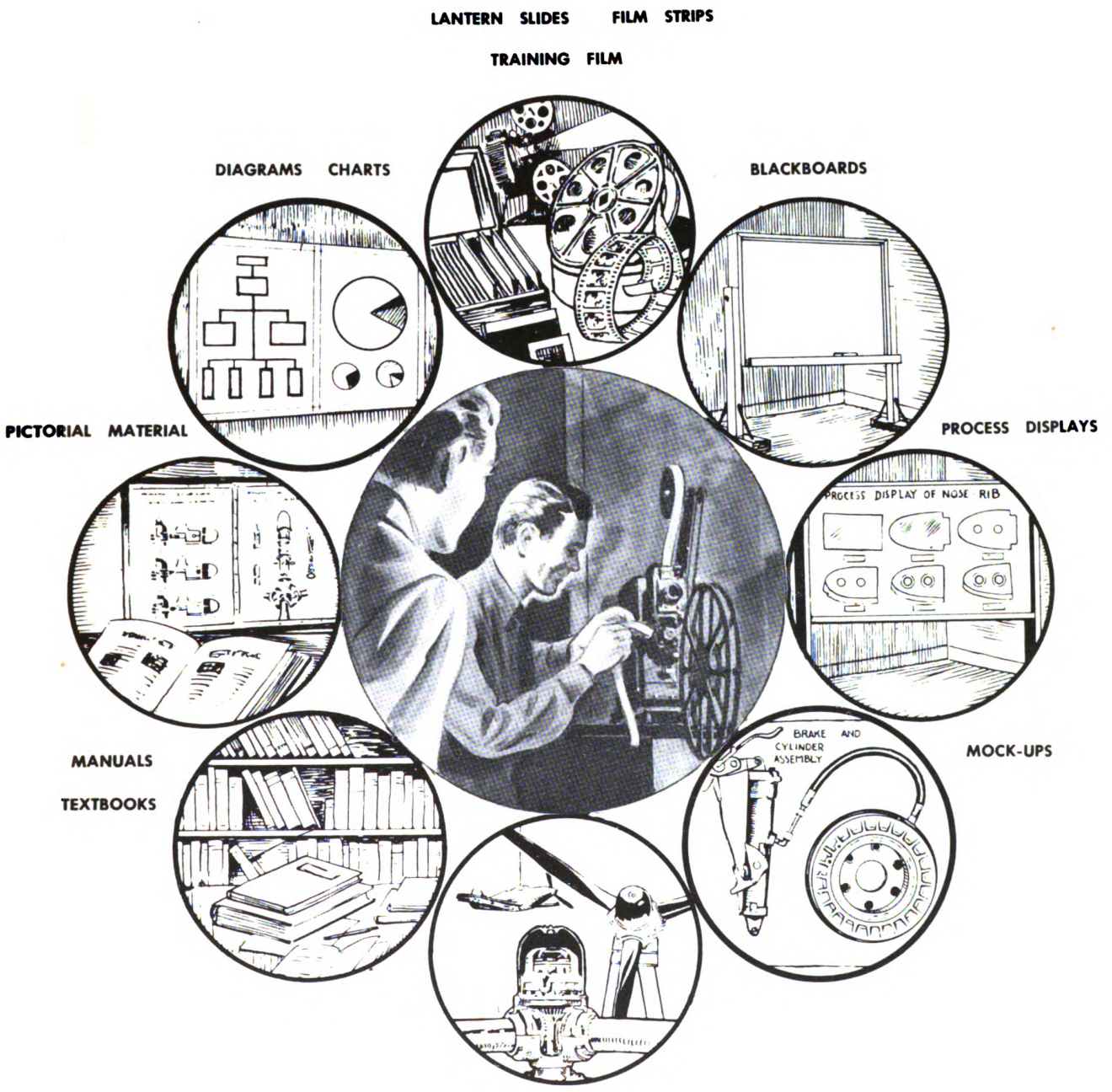
Chapter 9

INSTRUCTIONAL AIDS



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INSTRUCTIONAL AIDS

In any of your jobs or activities, you have no doubt prided yourself on being able to select the right tool for a given job, and to use that tool correctly. Whether you were assembling an engine, checking a long column of figures, or making a repair part, you saved yourself time by knowing which tool to use and how to use it. You did a better job because you used the right tools.

As an instructor you will have opportunity to use certain "tools," which will make the instructional process much easier and much more effective. If you are familiar with them and know how to use them properly, you will be able to save time and to do a better job. Among these instructional tools are the various devices known as instructional aids, such as motion picture films, mock-ups, and the like. To be effective, they must be used in accordance with the principles of learning which you studied in Chapter II.

Some of these instructional aids are called *visual* aids, which help the trainee to learn through seeing. Others may also be of the *auditory* type, which the trainee hears as well as sees.

Visual Aids	Visual-Auditory Aids
Film strips	Sound motion pictures
Silent films	Sound film strip
Lantern slides	
Opaque projectors	
Blackboard material	
Charts and diagrams	
Cut-aways, models and mock-ups	
Instructional guides, textbooks, and lesson sheets	

There are many special devices used for teaching special subjects. The electrical instructor might use the oscilloscope to show what is happening in an electrical circuit. The instructor of inspectors might use the X-ray machine to demonstrate the different kinds of flaws found in materials. In this chapter, you can find out how to use some of the more common devices such as those listed above.

I. FILM STRIP

A *film strip* is a series of individual pictures on a strip of film and looks much like motion picture film. There may be any number of these pictures on one strip, but usually about thirty or forty are used in a series. The pictures are projected on a screen or on the wall by means of a small projecting lantern. The film is turned one "frame" or picture at a time and is left on the screen as long as may be needed. The pictures may be of any type, including photographs, charts, drawings, or printed matter. You will find film strips convenient in many ways.

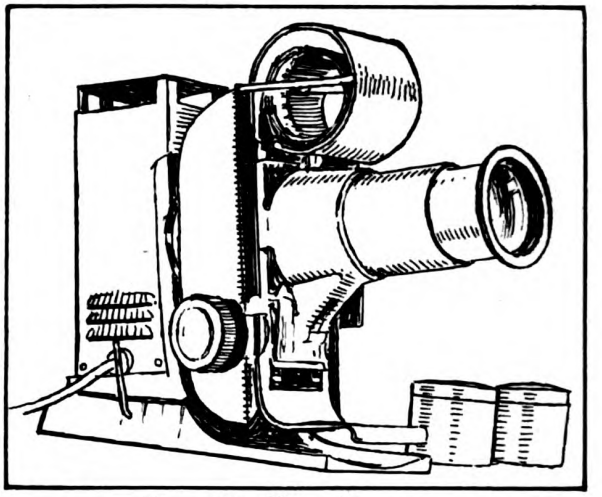

Figure 72—Film strip projector

A. ADVANTAGES OF FILM STRIPS:

(1) They can be shown against the surface of any blank wall if it is not in the direct sunlight.

(2) The equipment required for projecting film strip is very simple and easy to operate.

(3) Film strips are easy to store and transport.

(4) Since you can move the strip backward or forward in the machine, you can review any particular frame that needs emphasis.

Figure 73—A film strip

B. SUGGESTIONS FOR THE USE OF FILM STRIPS:

(1) Choose film strips that really fit the lesson you want to teach. If any particular frame is not appropriate, you can skip it as you move the strip through the machine. Use only the frames that have the greatest value for your instruction.

(2) Go over the film strip several times carefully before the lesson begins. Otherwise, if you try to study the material while you are showing the film, the trainees soon lose interest.

(3) Avoid showing too much material in one session. Ten or fifteen minutes spent in showing film strips are enough.

(4) Get the trainees ready before you actually show them the film strip. You might tell them what they should notice particularly.

(5) Follow up the showing of the film with questions, discussion, or a short test. The trainees will pay better attention if they know some check-up is coming.

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Each air depot has a large assortment of film strips. You should find out what strips are available in your field and use them whenever they will add interest or clearness to your instruction.

Sometimes film strips are used in connection with phonograph records, and the frames of the film strip are turned one by one to synchronize with the sound record. The sound record provides a definite signal at intervals, and the operator turns the film strip when he hears this signal. If you use this type of instructional aid, run the film and record through a time or two before your class session so that you will be able to keep the film synchronized with the record.

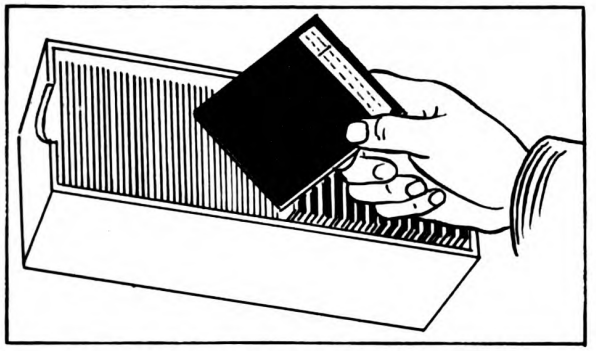

Figure 74—Lantern slides

II. LANTERN SLIDES

You can use *lantern slides* in much the same way as film strip, and the suggestions given above are good for slides as well as for film strips. Besides, it is easier to omit a slide than to hurry through an unimportant frame in the film strip.

If you have ever sat in an audience while a lecturer shuffled through his slides trying to find the proper one, or to get them in the right sequence, you understand why you should go over the slides carefully before you start showing them to the trainees. Use only the few, particularly appropriate slides that are directly related to the instruction. Discuss them carefully before and after you have shown them.

Colored slides are especially useful for showing operations, equipment, and the like where color is an important factor.

III. PROJECTION OF PRINTED ILLUSTRATIONS AND MATERIALS

When you wish to project on the screen some picture in a textbook or a Technical Order, an "opaque" *projector* is very useful. The illustration is held in position, usually at the bottom of the projector, and the image is thrown upon the screen. Sketches or drawings are often projected in this manner. It is sometimes used by electrical instructors to show meter readings. A meter which is connected in a circuit may be placed beneath the projector. Thus, the face of the meter is projected on the screen, and movements of the meter pointer across its dial can be seen by all trainees.

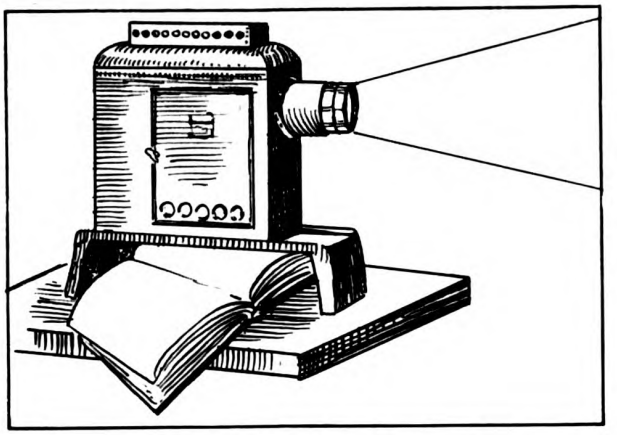

Figure 75—The opaque projector

Figure 76—Training films and slides

IV. TRAINING FILMS

Both silent and sound motion pictures are most effective in your shop or classroom when they show materials and operations that cannot be given to the trainees in any other way. If you cannot show them real machines of the size and type they will use, your best substitute may be a *training film.*

Always select training films with great care, and plan their use as you would plan a lesson. Prepare your trainees for the material they will find in the film, and test them after you have shown it. The following plan shows in detail how to arrange an instructional period in which you use film of any kind.

A. WHAT THE INSTRUCTOR SHOULD DO BEFORE THE INSTRUCTIONAL PERIOD:

(1) Choose a film of *proper length.* It may last from 15 minutes to an hour; but usually, the shorter it is, the better.

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(2) Decide definitely on the *purpose* of the film. Although there are a number of purposes, you are likely to use a film for one of these three:

a. To show a particular operation or series of operations.

b. To give an overview of the course.

c. To explain a fundamental principle.

(3) The *content* of the film you choose should:

a. Be simple, understandable, and real to your trainees.

b. Show the skills, information, and attitude you expect the trainees to develop as a result of the particular lesson or the course as a whole.

c. Demonstrate operations clearly and correctly. Difficult operations should be shown in slow motion.

d. Be adapted to your trainees' needs at the moment. The films should be neither too advanced nor too elementary.

(4) Sometime before the lesson, arrange to have the equipment set up. Be sure that the seating arrangements in the room are convenient.

B. GETTING THE TRAINEES WARMED-UP:

(1) Explain to the class the purpose of showing the film.

(2) Tell them the main features of the film, that they should observe.

(3) Announce your intention of holding a class discussion or quiz on the film after they have seen it.

C. SHOWING THE FILM:

(1) You can make comments during the showing if you are using a silent film.

(2) If possible, remove all distracting influences, such as unnecessary light, noise, or activity.

D. AFTER THE FILM HAS BEEN SHOWN:

(1) Ask appropriate questions in written or oral form.

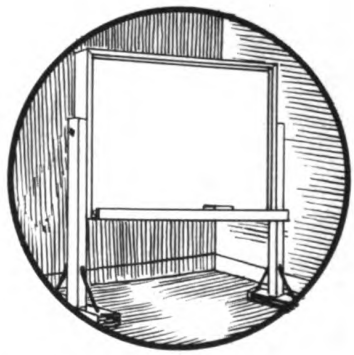
(2) Conduct a discussion about the film.

(3) Summarize the main points of the film before dismissing the trainees.

(4) If the material presented by the film is difficult, you may have to show the film a second time.

V. THE BLACKBOARD

You will probably use the *blackboard* more than any other visual aid because it is convenient and usually available. Most classrooms and shops are equipped with blackboards. If you need to improvise one, use thumbtacks or clips to fasten a wide strip of wrapping paper to wood or wallboard surfaces, and use heavy crayon to mark on it.



Here are some types of material that can be put on the blackboard:

(1) Sketches.

(2) Diagrams.

(3) Outlines.

(4) Definitions.

(5) Directions and assignments.

(6) Summaries.

(7) Examinations.

(8) Supplementary information.

Sometimes you may ask an individual trainee to recite from material on the board or to solve a problem at the board while the others watch. If you have enough blackboard space, you can send the entire group to the board to work out problems.

In order to use the blackboard most effectively, you may be interested in the following suggestions:

(1) Keep the blackboard clean so that the chalk marks are fresh and clear.

(2) Regulate the lights to avoid glare.

(3) Use readable letters and figures large enough so that they can be seen by all trainees.

(4) While you are talking about the material on the blackboard, face the trainees and not the blackboard.

(5) Stand at one side of the work that is being discussed.

(6) Use a pointer to explain the material you have written on the blackboard.

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(7) Arrange blackboard material in a neat and orderly way.

(8) Erase material not needed by you or the trainees.

Figure 77—Don't talk to the blackboard

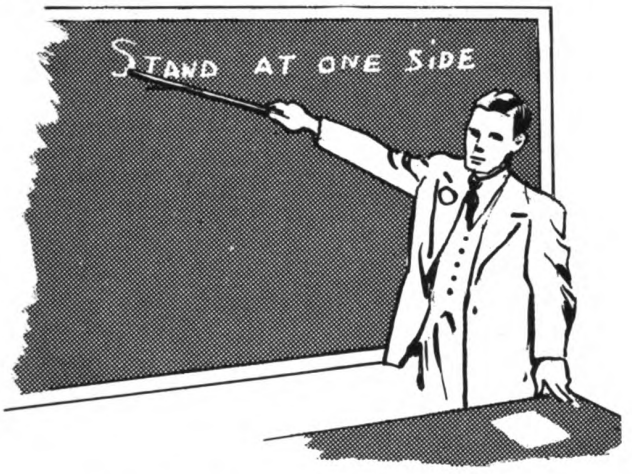

Figure 78—Stand at one side and use pointer

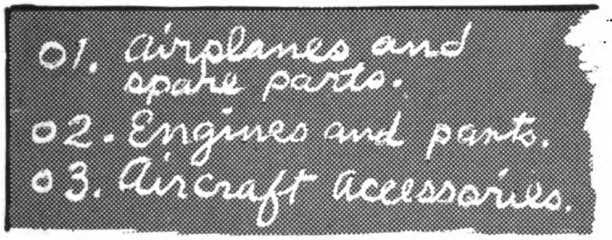

Figure 79—Use orderly arrangement of written material

For sketches, drawings, or diagrams, you can get the best effect by sharpening your chalk. To draw narrow distinct lines, use a pointed chalk. For broad lines, use a chisel-pointed chalk.

To emphasize or distinguish certain parts, use colored chalks for lines, or shaded sections of drawings or diagrams. Colored chalks add interest and bring out the high points of a lesson.

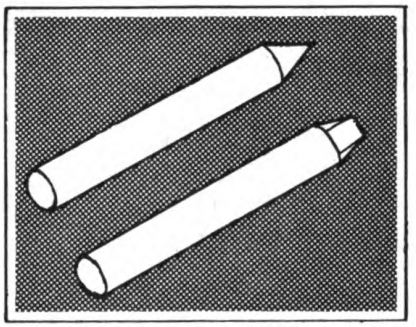

Figure 80—Sharpen chalk for wide or narrow lines

VI. CHARTS, DIAGRAMS, AND GRAPHS

Pictures often give information much more vividly than words. Likewise, *charts, diagrams,* and *graphs* are useful to impress trainees with information otherwise difficult to present. Whenever you have long lists of figures to be compared, try to put them in a vivid chart or graph. Often you can find prepared materials ready for use in class. Small charts can be projected on the wall from the opaque projector previously described. Several types of graphs and charts are shown. in figures 81 to 84.

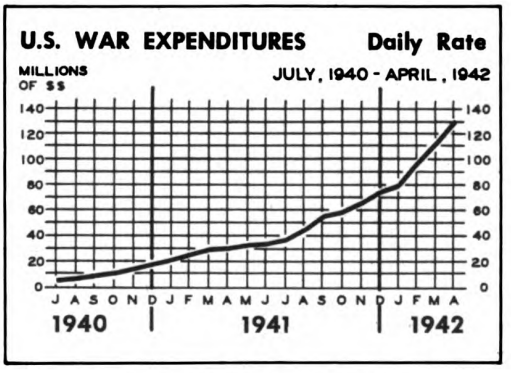

Figure 81—Curve graph

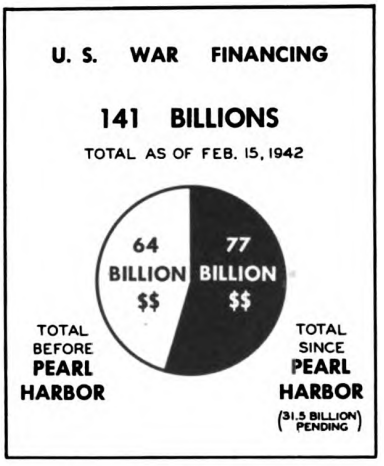

Figure 82—Circle graph

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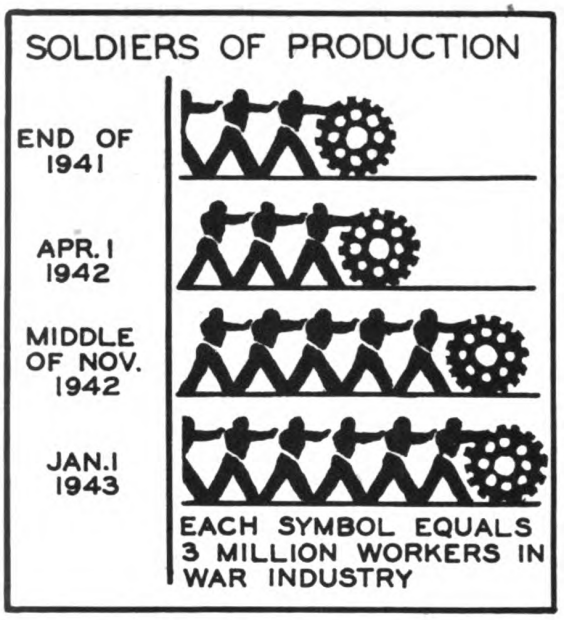

Figure 83—Picture graph

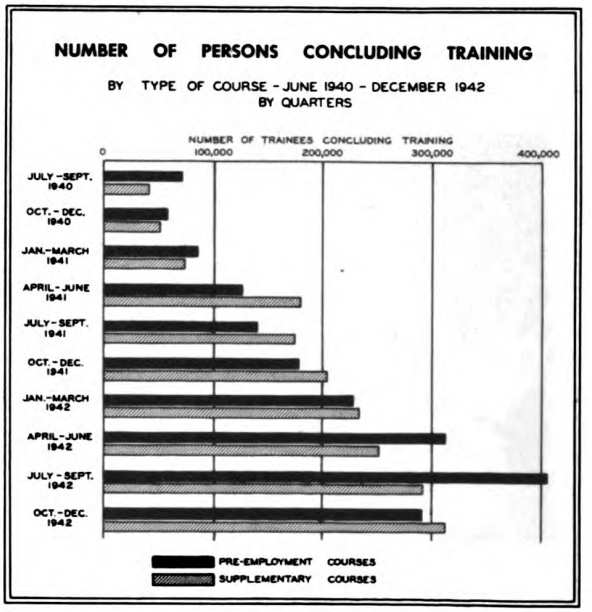

Figure 84—Bar graph

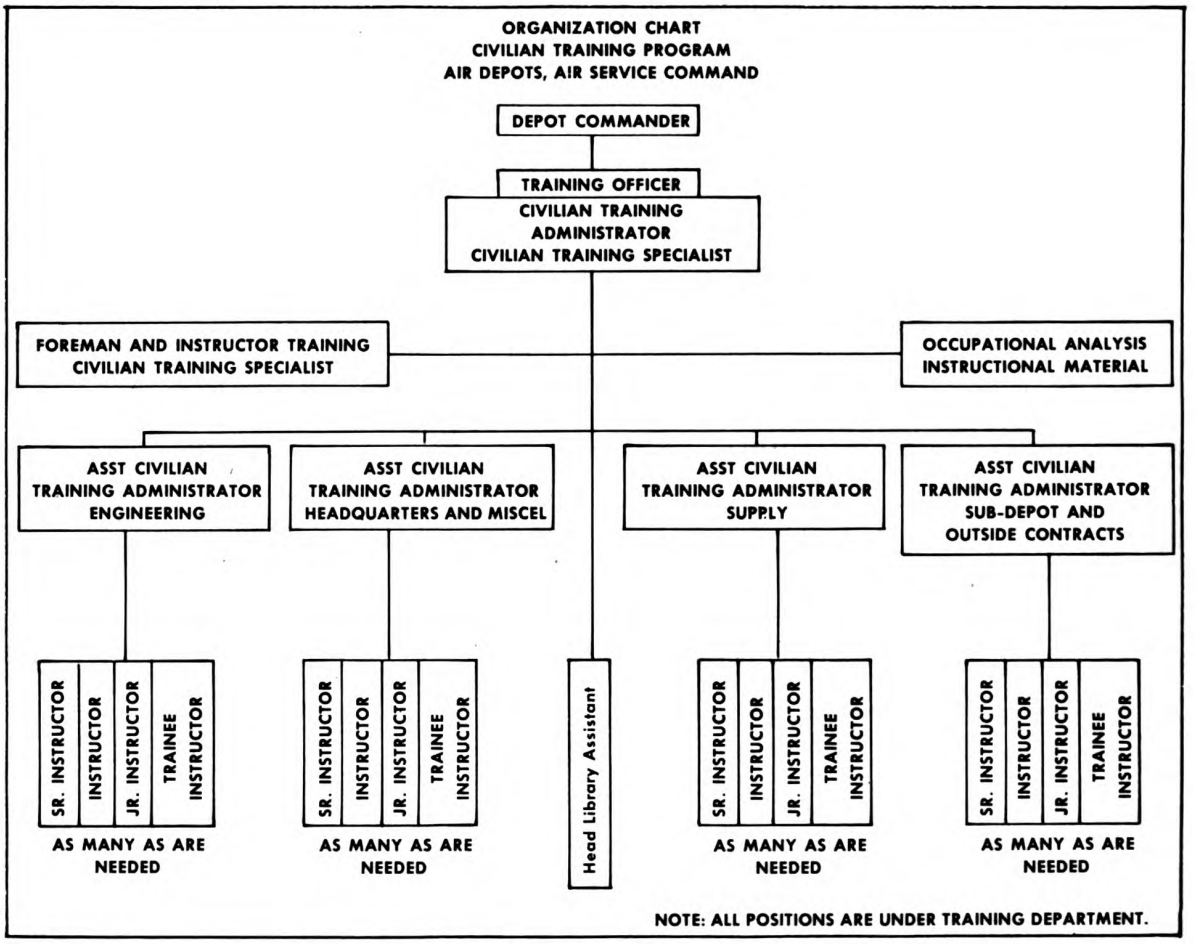

Figure 85—Organization chart

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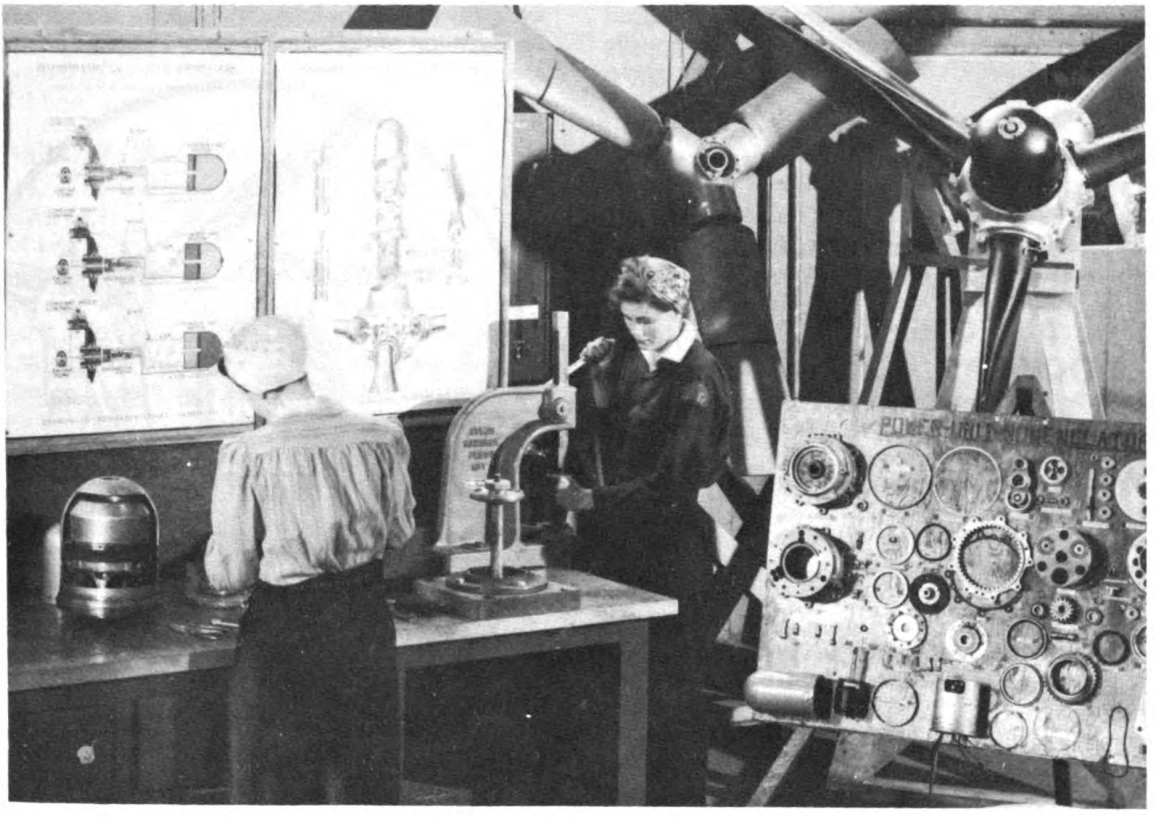

Figure 86—Wall charts and display panel

Figure 87—Instrument panel and wall charts

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Another useful form of illustration is the Organization Chart. In figure 85, such a chart shows the organization of the civilian training program at an air depot.

In figure 86, you can see how diagrams on wall charts can be used in a shop where trainees are learning to work with hydromatic propellers.

For pictorial material in general, wall charts often help trainees understand more clearly the nature of operations, material, or parts of objects.

VII. OBJECTS, CUTAWAYS, MOCK-UPS, MODELS, AND PROCESS DISPLAYS

Actual objects may be used to illustrate and demonstrate your lesson. Trainees may also use these objects to apply directly what you have taught. In figure 87, the trainees are looking at the gyro horizon indicator on a real instrument board from a plane.

If cutaway parts are used, trainees can examine carefully the nature of operations normally hidden from view. The value of cutaways in teaching how something operates is suggested by comparison of the cutaway illustration in figure 88 with the propeller in the background of the same picture.

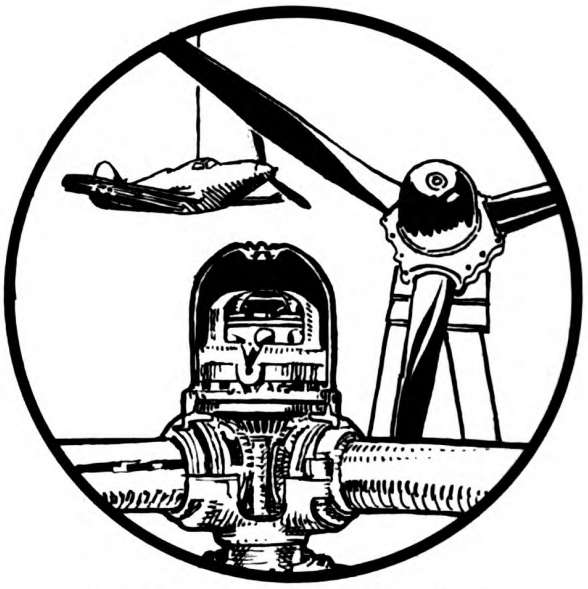

Figure 88—Cutaway propeller mechanism

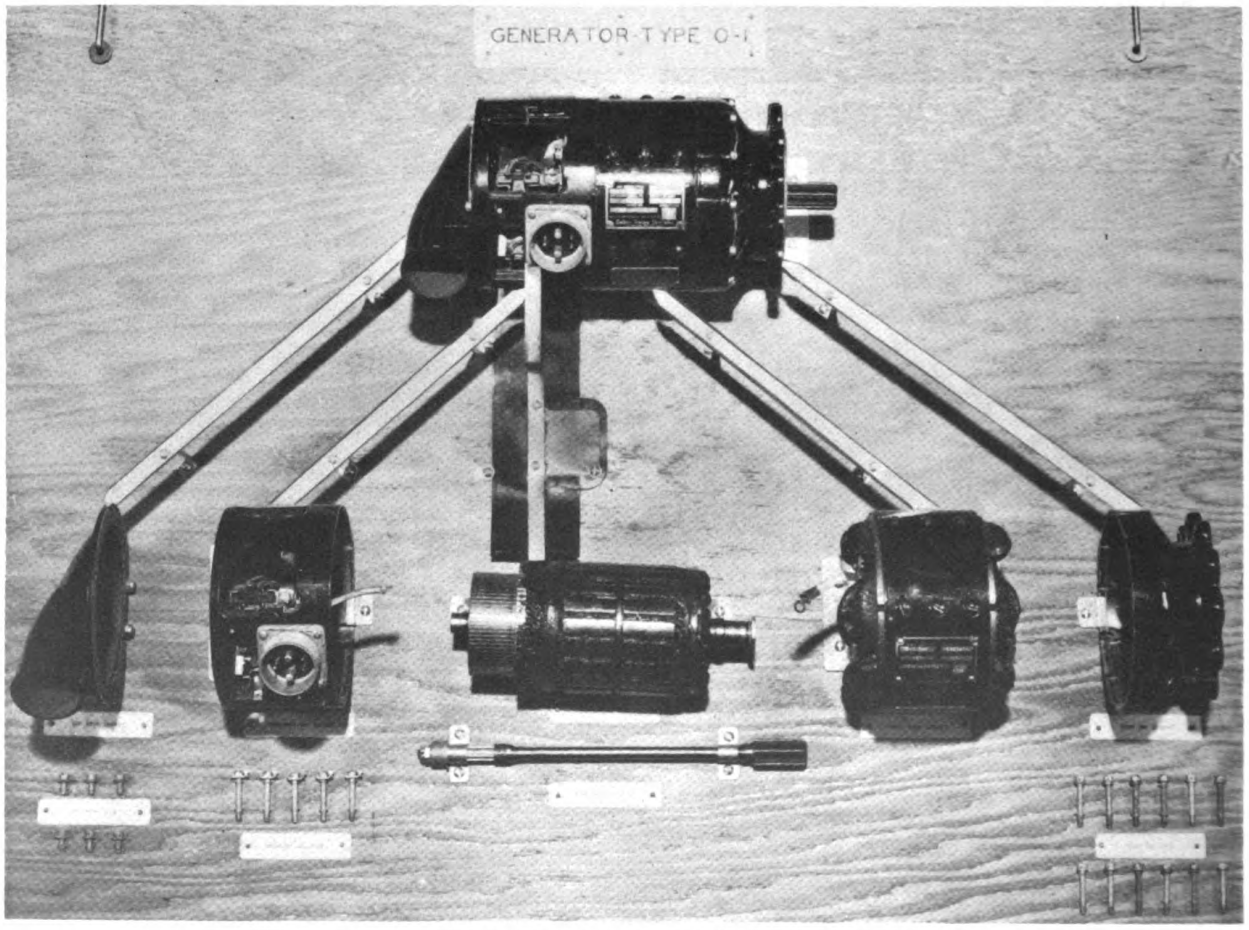

Figure 89—Generator display board

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Mock-ups show disassembled objects, assembled objects, or complete systems mounted on an instructional panel or stand. Here are kinds of mock-ups that you will find most useful:

A. DISPLAY BOARDS

(1) Show disassembled objects, such as the parts of a magneto or starter to teach the names and constructions of parts.

Figure 89 shows a display board with the parts of a generator on the lower half. If the parts were numbered, the order of assembly could also be made clear.

(2) Show assembled objects to make clear the construction and assembly of the whole mechanical unit. The pointers on the display board in figure 89 show the relationship between the parts and the entire generator.

B. DEMONSTRATION BOARDS

A complete system, such as the hydraulic system, electrical system, radio system, or fuel system, may be *mounted on a board* so that it operates just as it would on an airplane. You will find that this kind of mock-up is particularly useful in demonstrating the assembly and operation of a system, the methods of trouble shooting, and the procedures for maintenance and repair. In figure 90, a small board of this type shows a brake and cylinder assembly.

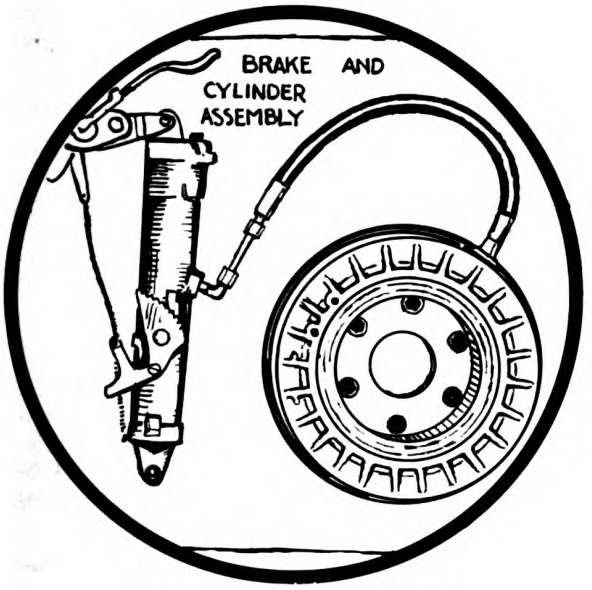

Figure 90—Hydraulic mock-up

Models are useful devices in teaching many subjects. If commercial models are not available, you or the trainees can construct a model from improvised materials or worn-out parts. A model airplane is shown in the background of figure 88.

A *process display* shows the various steps in the manufacture of an article, such as an aircraft engine forging, nose rib, spar, or propeller. Often these displays show the raw materials from which the product is manufactured. (See figure 91.)

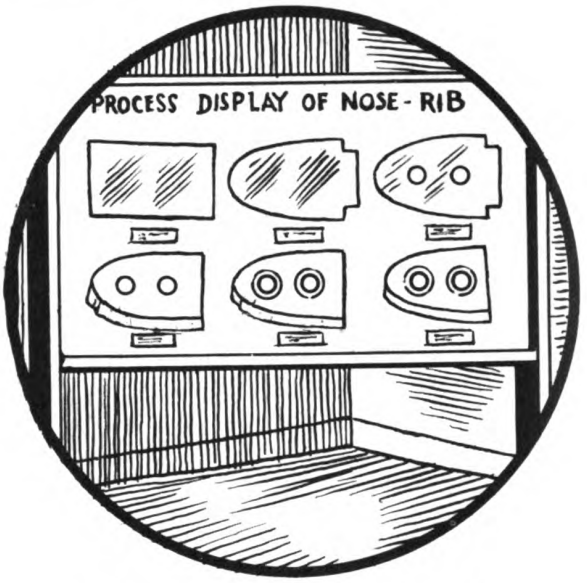

Figure 91—Process display of nose rib

Figure 92—Technical Orders and manuals—Good instructional material

VIII. TEXTBOOKS, MANUALS, AND TECHNICAL ORDERS

Printed instructional material of one sort or another forms the backbone of the instructional aids used in most training programs. In air depot training, the more commonly used materials include *Technical Orders, Instructional Guides,* and other *Training Manuals.* If a special instructional guide has been prepared

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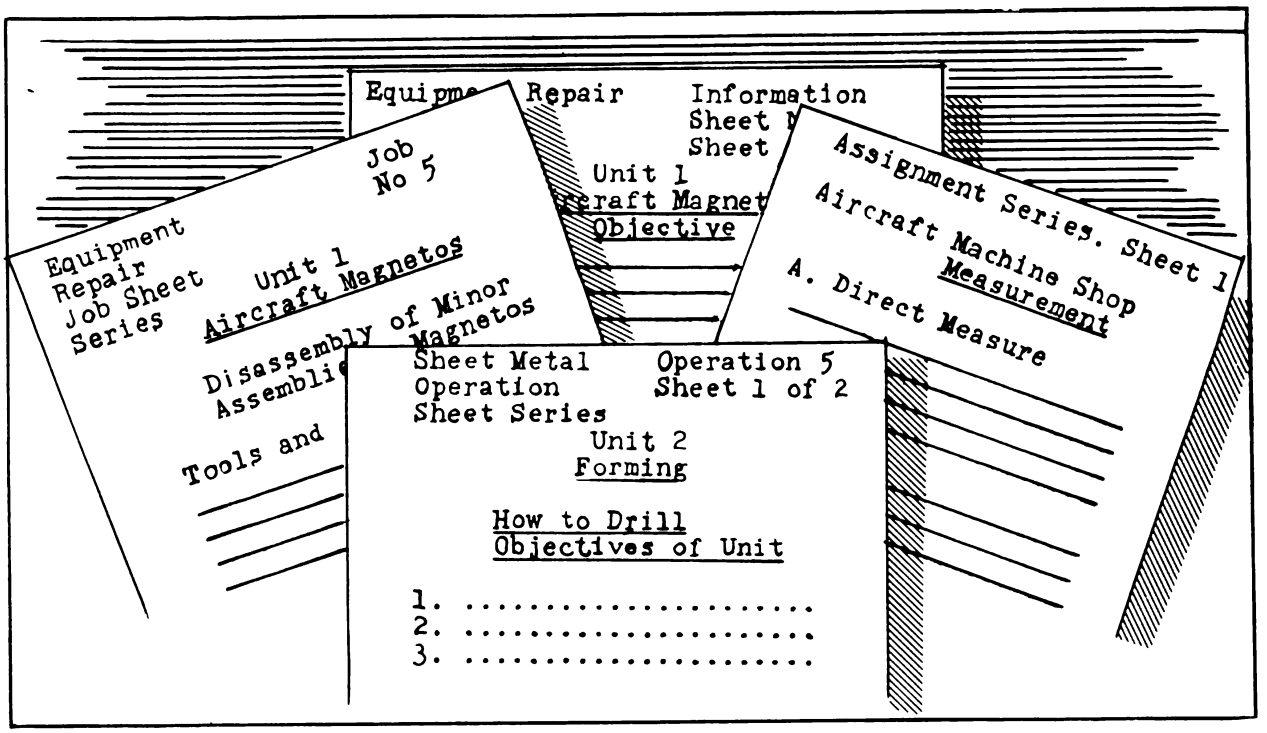

Figure 93—Instruction sheets

for the course under the direction of Headquarters, Air Service Command, this should be the main source of information. Technical Orders also are important for procedures and for supplementary material; and when special instructional guides are not available, Technical Orders are the main source of information.

Sections of the Instructional Guide, Technical Orders, Manuals, or other material may be assigned for trainee study in connection with each daily lesson or used as a guide for shop or laboratory work.

When no special material has been prepared for the course, you will have to choose among the materials that are available. Study these carefully and pick out that which best suits your group.

IX. INSTRUCTION SHEETS

Written or printed instructions of all kinds are of great value where specific directions must be given to members of a group who have different interests, backgrounds, and abilities. *Instruction sheets* are particularly effective in individual instruction for either the shop or classroom. They permit trainees to progress independently of other members of their group, and at their own speed. Instruction sheets save the instructor unnecessary explanations and enable him to give help where it is most needed.

Special forms of the instruction sheet differ from each other in organization and purpose. Their content is based upon an analysis of a trade or units of instruction.

A. TYPES OF INSTRUCTION SHEETS

(1) **Job Sheets** explain in detail how to complete jobs which may require a number of operations or units of instruction.

(2) **Operation Sheets** explain how to perform the operations you wish the trainees to master.

(3) **Information Sheets** give additional facts connected with jobs, operations, or assignments. They explain such items as these:

General principles.

Related subject matter.

Definition of trade terms.

Description of tools, machines, and materials.

Explanation of how units operate.

(4) **Assignment Sheets** are written to direct reading, observation, and drill. They often contain large numbers of questions.

As soon as you are familiar with instruction sheets, you will find many advantages in their use. Here are a few of the more important reasons for using them:

B. ADVANTAGES OF USING INSTRUCTION SHEETS

(1) You need not repeat talks or reviews already given, since the trainee may find the material on his instruction sheet whenever he needs it.

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(2) The way a trainee uses instruction sheets often shows much about his ability. An incompetent trainee requires more personal attention and explanation from the instructor. A competent trainee may work ahead quietly and correctly, simply following the instructions on the sheets.

(3) Instruction sheets may be changed easily when new equipment or new methods of processing work are introduced.

(4) Regular use of instruction sheets teaches a trainee to read and follow directions. It also reduces the number of questions which an instructor must answer.

(5) Instruction sheets allow trainees to progress as rapidly as they can without disturbing slower members of the group.

C. HOW TO USE INSTRUCTION SHEETS

(1) Find out what instruction sheets are available. If the sheets are not exactly suited to your needs, add material to them or change parts of them.

(2) If possible, begin using instruction sheets at the very first meeting of the class. Make sure that such sheets contain the necessary information.

(3) Get the trainees ready to use the information sheets by explaining their advantages before passing them out. Remember that many trainees would rather get information from you than from the printed page, and your enthusiasm about an information sheet may sell them the idea of looking at it instead of asking you.

(4) Then, show the trainees exactly how to use the instruction sheets. If you are conducting a demonstration, have one of the trainees read aloud the steps of the operation while you or another trainee perform the operation explained. This method also shows clearly the value of instructional sheets to the trainee.

(5) After the first instructional period, guide the trainees in their use of the instruction sheets until they habitually and independently use them. If a trainee persists in asking you instead of referring to his sheet, you may direct his attention to the part of the sheet which answers his question. A better plan is to have another trainee read that part to him.

(6) Instruction sheets should be available to trainees at all times; otherwise, they get into the habit of leaning on you as a source of information.

(7) Whenever possible, introduce novel and interesting ideas in addition to the information sheets, to prevent the jobs from becoming routine. These extra ideas can be introduced during your demonstration or shop talk.

Figure 94—Choosing visual aids

X. CHOOSING AND USING INSTRUCTIONAL AIDS

You have now discovered what each of these instructional aids is, how it is used, and its advantages and disadvantages. If all these tricks of the teaching trade were in your instructional tool box, which ones would you use and how would you arrange their use?

In any course, you need to use the blackboard, textbooks and manuals, charts and diagrams. The skillful use of these ordinary aids is the mark of a good teacher. Observe the results you get with them, and try constantly to improve.

Whenever pictorial materials are available or instructional trips are possible, you will find that they add great interest to almost any class work. Names of parts and assembly procedure can be shown readily by display boards. When parts are to be constructed from raw materials, you can show the progressive steps of production by process displays. One of the best ways of demonstrating the operation of equipment is to use cut-away objects or working models.

Find out whether the equipment for silent and sound film is available to you; "movies" always combine entertainment with learning. Motion pictures are best adapted to give an overview of the material to be taught in the course, or to show operation. Film strips

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are very practical because they are easily available, easily adapted to the lesson, and easily repeated for emphasis. Where colors are an important part of the lesson, as in teaching color codes or the significance of exhaust flames, you would be wise to select lantern slides.

For individual instruction, the use of job, operation, information, and assignment sheets is absolutely necessary.

In actual practice, you begin by using the instructional aid or tool which best suits the material you are teaching. If materials for these aids are limited, use them ingeniously and often. If materials are plentiful, select them carefully and arrange for variety. Do not lean always on the basic aids of the blackboard and diagrams if moving pictures and display materials are available. Space your use of devices so that the trainees are always alert for something new in the lesson; your teaching methods should not become a routine predictable by the trainees.

Test your use of instructional aids in three ways: First, the material should **be absolutely clear** to the trainee. Second, it should **serve the purpose** of the lesson. Third, it should **save time** in learning, not waste it.

Keep a sharp lookout for new devices, and new applications of old ones. Your tools of instruction not only keep the trainees interested, but also add zest to your teaching as well.

QUESTIONS

(1) What material in your specialty could be most effectively presented in film? Find out, if possible, whether or not this particular material is available in film, film strip, or lantern slides.

(2) If films are not available for the material listed in the first question, what instructional aids can you substitute?

(3) Make a chart or diagram that will be useful in your instruction.

(4) What manufacturing companies might supply pictorial material for your specialty?

(5) Sketch a plan for a demonstration board or a display board that will be helpful in your instruction.

(6) Make up one instruction sheet for a particular lesson.

(7) Check any of these instructional aids you have just prepared according to the three tests suggested in this chapter.

(8) What visual material is available for your courses at your depot?

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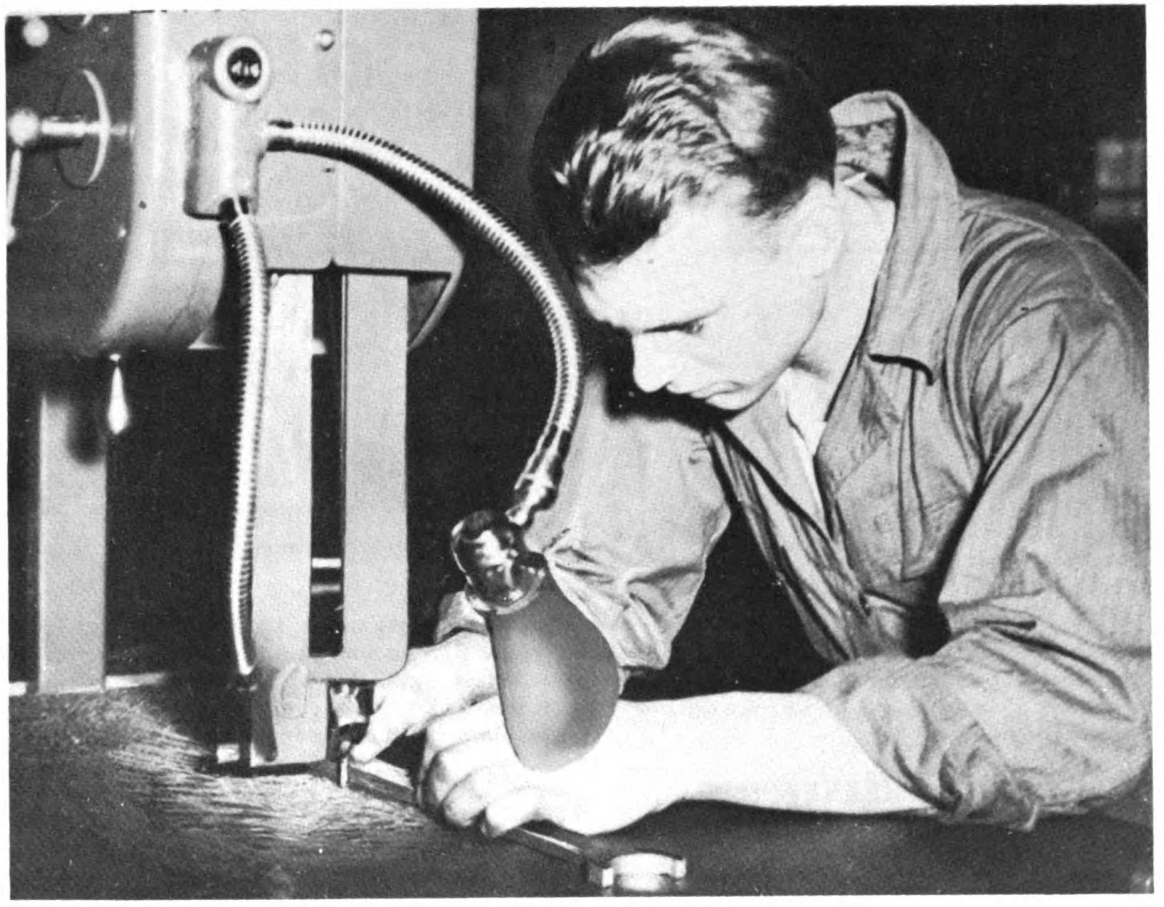
Chapter 10

INSTRUCTIONAL MANAGEMENT



The instructor looks at his job of managing trainees and considers the care and use of equipment.

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INSTRUCTIONAL MANAGEMENT

Can you remember the bicycle shop with its neat rows of new and rebuilt bicycles along the walls, its labeled drawers for repair parts, and the workroom with the bicycle frames on a rack and tools on a tool board?

On the other hand, have you ever seen a mismanaged bicycle shop? Here, the new and damaged bicycles are strewn haphazardly about the salesroom, and old tires and inner tubes are draped over the handlebars or thrown on the floor. Used and new bicycle parts are scattered over the work table in the corner. Light cords running from wall sockets twine around bicycle frames, and one of them leads to a lighted drop light on the floor. Nearby is a pail of dirty kerosene surrounded by parts of a disassembled coaster brake. You can hardly avoid stepping on parts and tripping over light cords.

Suppose you were given the job of showing someone how to repair bicycles in a shop as poorly organized as this one. How would you reorganize the shop? What would you do first?

I. GOOD HOUSEKEEPING

If you decide to clear up the mess first, you have to **pick up, clean up, and put away** everything from the smallest nut and screw driver to the finished bicycles. And if you are really smart, you ask your helper to work with you in clearing up the shop. In this way, he can learn about storage, care of tools, and shop clean-up.

A. STORAGE—A PLACE FOR EVERYTHING, AND EVERYTHING IN ITS PLACE

At the depot, your training shop or office may be in smooth running order. If it is not, you will save yourself time and temper by straightening things out at the beginning and introducing a system that will keep them straight.

Storing materials is as good a place to begin as any other. Bar steel and sheet aluminum should be stored in well-designed racks. Bolts, nuts, rivets, and other small items should be kept in appropriate bins or boxes. Glass supplies should be put away carefully to prevent breakage. In the office, mimeograph stencils can be ruined by putting them on shelves near radiators; instead, store them in a cool, dry place. Keep in mind protection from damage, as well as orderliness and convenience of use. Follow those practices of storing material which are approved and practiced by the Depot Supply unit, whenever possible.

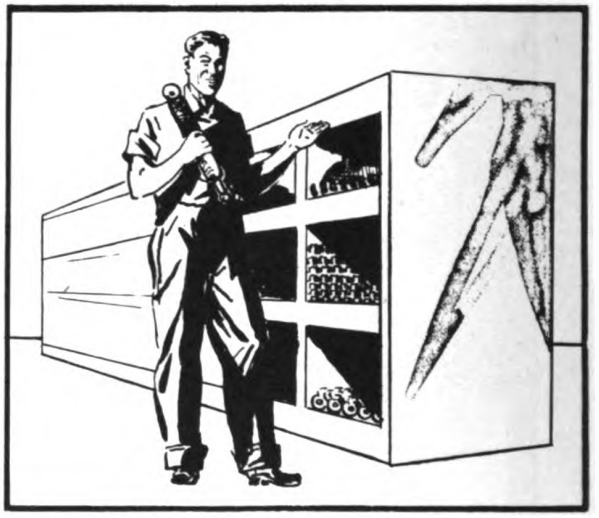

Figure 95—Store materials and parts in open bins

Keep everything in sight, if possible. Forgetting where you put something results partly from putting it out of sight. If you can make a visual inspection easily, you will avoid duplicating materials on hand or running out of needed equipment.

Storing hand tools requires adequate space on sidewall panels, shelves, racks, and in central tool cribs and cabinets. Use the facilities that are provided, and, if necessary, improvise others in any available space. Hooks may be used to hold many small tools in place. Drills, bits, chisels and the like fit in holes on special tool boards. Machine accessories and special tools may be stored in the main tool crib or in separate places near the machine.

A special place should be provided for each tool. If you draw the outline of the tool as a background around its hook or place on the tool panel, you can inspect the tools easily for loss or breakage at the end of each session or day. To help the trainees learn tool names, label each tool or its place. You can mark the names on the tools by stamping, etching, or painting. Figure 96 shows a convenient and well-planned hand tool storage panel in the background.

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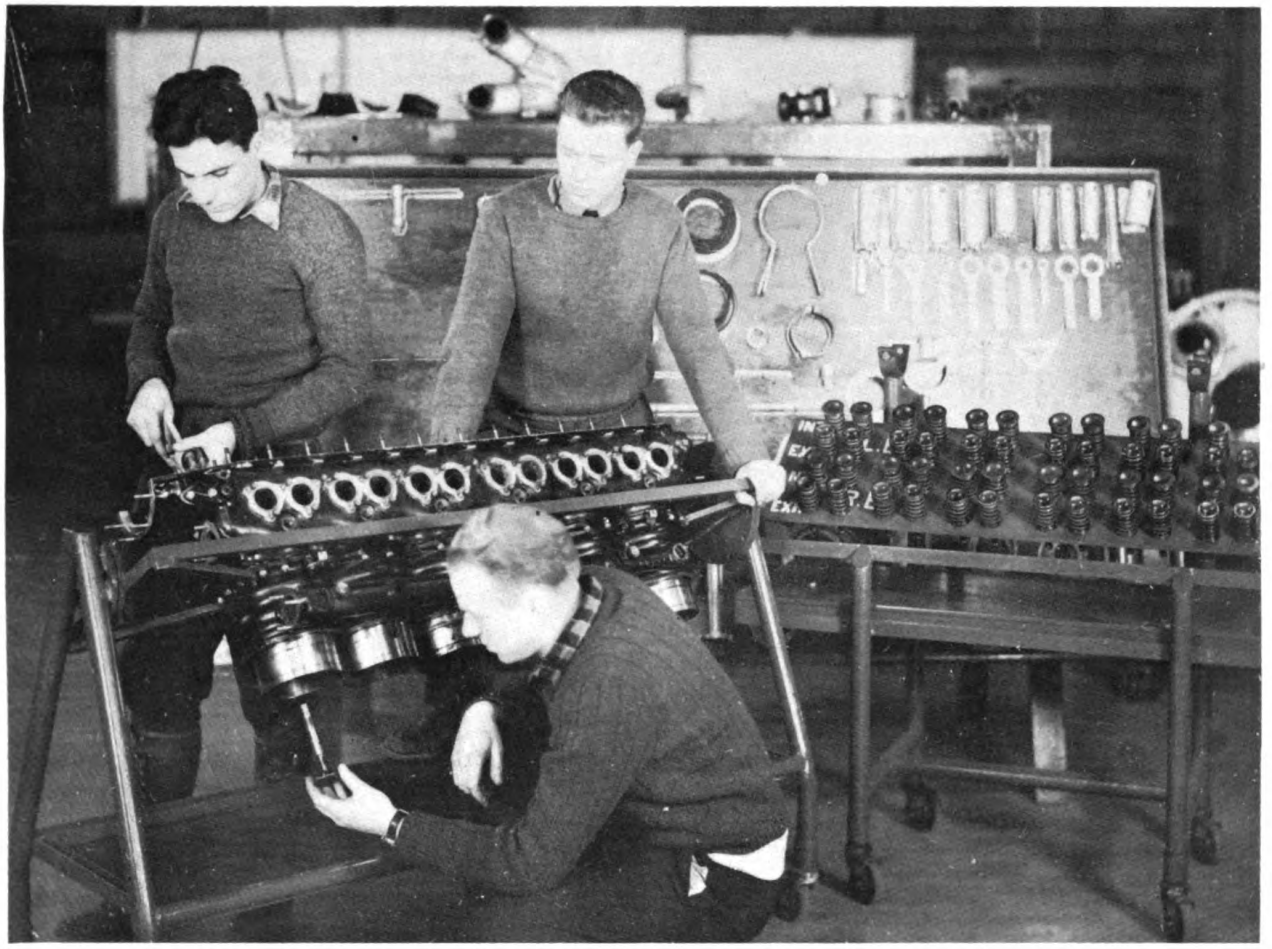

Figure 96—Tool panels and parts stand

Storing the finished and unfinished work of the trainees is required in most shop situations. Sometimes the unfinished work can be left at the trainee's work station at the end of the session. Usually, small equipment or accessory jobs, such as carburetors, superchargers, and electrical instruments should be safely put away on stands, in bins, racks, drawers, or cabinets.

Figure 97 illustrates how the parts of a disassembled Pratt and Whitney aircraft engine are separated and stored on engine overhaul stands and on special stands used for parts.

The personal belongings of the trainees need to be cared for in lockers or cabinets which can be locked. Since many of the trainees may have their own small tools, space for their storage should be provided.

B. CARE OF MACHINES AND TOOLS

You are responsible for the condition of the tools and machines in your shop or classroom. As a careful worker, you understand the importance of keeping them clean and in good repair. As an instructor, you are also expected to have an accounting system so that you know where they are at all times.

All machines and tools should be cleaned after each period of use. In addition, most machines need special care. Before using a machine, you or the trainee should check it for lubrication. If trainees are to do this work, you should teach them the location of oil holes and grease fittings, and the kind and quantity of lubricant to use.

Machine belts should be occasionally dressed, tightened, and checked for wear. All machines should be tested and adjusted periodically for bearing wear, alignment, safety of electrical and mechanical devices, gear wear, couplings, and other common mechanical defects. Typewriters and other office machinery should be cleaned often and oiled and adjusted whenever necessary.

Although shop clean-up is one of your definite responsibilities, it is wise for you to find out how this work is customarily done in the depot. How much cleaning the trainees do should be determined not only by the need for their help but also by the value of such training. At least, each trainee should consider as a part of his job the cleanliness and orderliness of his machine, bench, or work station down to the floor.

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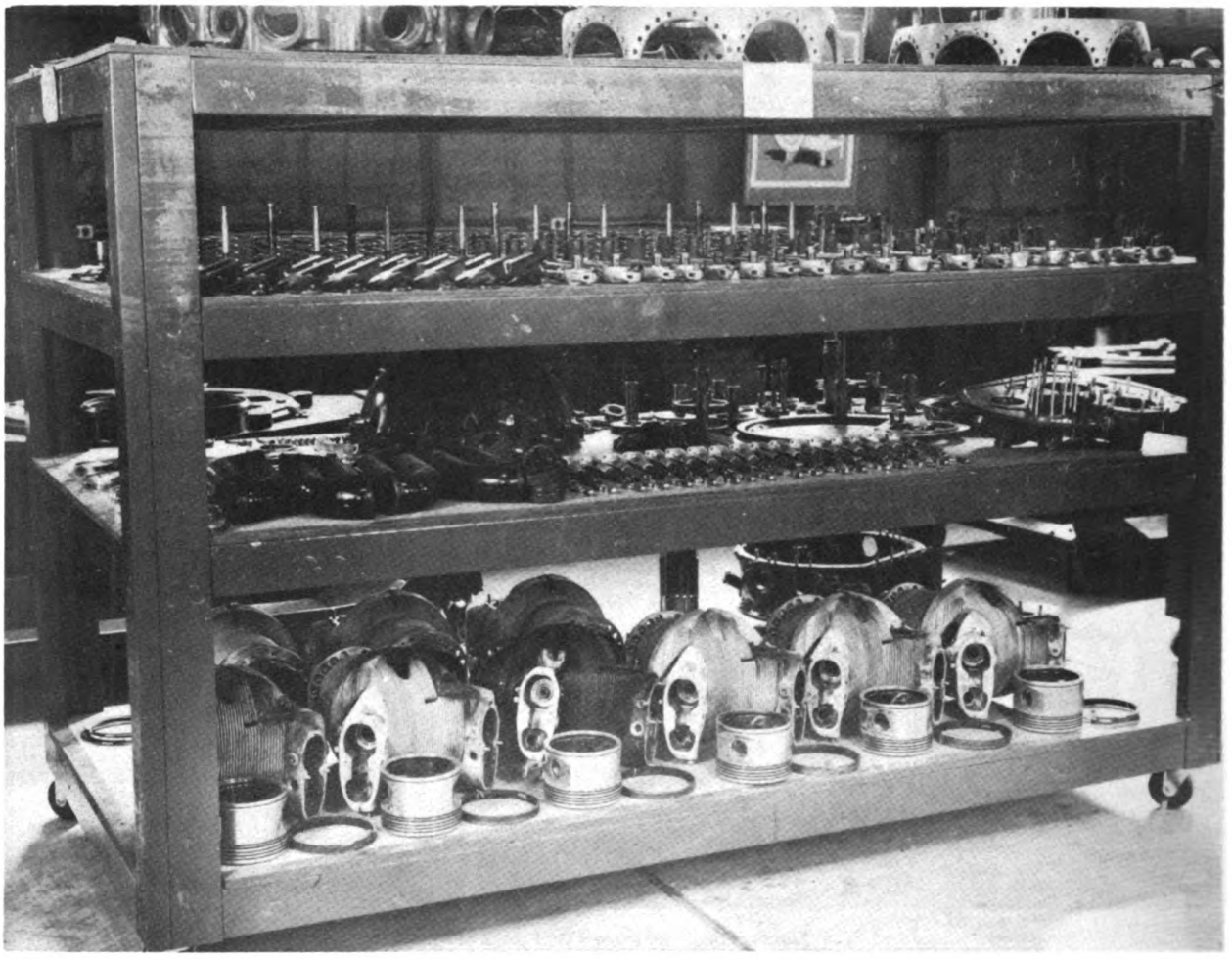

Figure 97—Store engine parts on portable stands

In some depots, he may also be expected to sweep the floor. The average trainee takes this work in his stride as part of his job if he is told about it when he enters the shop.

It is particularly important that a trainee should immediately become acquainted with the tool and accessory accounting system. Whatever system you introduce or find established in your shop, the trainee will probably have to learn the use of tool checks, tool requisition blanks, or tool accounting forms.

Tool checks are usually made of metal and are marked with a number or other means of identification. Each trainee is given a number of these checks, all bearing the same number or symbol, to use in exchange for the tools he takes from the tool crib. The tool crib clerk usually hangs the check in the place of the issued tool or accessory. In this way, the tool crib clerk can always tell which trainee has received any particular tool. The disadvantage of these checks is that trainees can easily lose or misplace them.

Tool requisition blanks commonly call for the name of the trainee, the department in which he works, the date of requisition, the name of the tool and possibly the use for which it is desired. In some places, the signature of the instructor is required before the tool can be issued. Upon the return of the tool to the crib, the trainee is given his slip.

Tool accounting blanks require information similar to that on the requisition slips, but the tool crib clerks do all of the accounting. In one column are all the trainees' names or numbers and opposite each one is space for the name of the tool withdrawn and any other notes. As these accounting forms are made out, signed by the tool crib clerk, and filed for each day, it is possible to find out the last one to use a tool that is missing or damaged.

II. SHOP LAY-OUT

Although you will probably be assigned a shop already arranged, you may be able to improve its

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lay-out. At least, you will want to study your shop to make sure that the machines, tool racks, cribs, benches, lockers and other equipment are arranged for efficiency of instruction, safety, and convenience.

If possible, the equipment should provide for a production sequence with the least possible movement of equipment and materials. If a piece of work should be processed on two lathes and a drill, you can ask the trainees to use the machines that are closest together in the shop. Be on the alert for minor changes which will make the work more convenient for the trainee. For example, putting a table beside a machine to receive the finished parts may be a handy arrangement that a trainee will appreciate.

The position of the machines is also related to safety. You may find it desirable to provide lanes of travel at a safe distance from those machines and tools which are in constant or frequent operation. For certain machines you may mark off danger zones or working space that trainees should not enter when another trainee is operating the machine.

You should be constantly alert for improvements in your shop lay-out. These improvements will occur to you readily if your desk is near the hub or at a point of vantage where you can do your work with the least amount of distraction, and yet see what is happening at each work station. Major changes in the lay-out of the shop should be referred to your superior with your reasons for suggesting the change. Minor changes in arrangement which can be made for a single instructional period are likely to be considered within your authority.

Figure 98 shows a shop where conditions are conducive to good teaching and learning.

III. VENTILATION AND LIGHT

You are aware that discomfort resulting from poor ventilation and bad lighting can affect your efficiency. Now that you are an instructor, you are responsible for keeping trainees from being distracted by the discomfort of a stuffy room or a glaring light.

Figure 98—A machine shop lay-out

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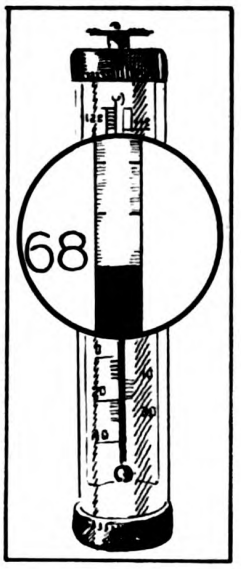
By experimenting with the lighting and heating equipment available in your shop or classroom, you can soon find the best method of adjustment. Each time you enter a classroom or shop, you should develop the habit of checking quickly on the ventilation and light. What is the temperature? Is the room stuffy? Is there enough light? Does it strike the right places? Is there a glare? The answers to these questions suggest the immediate adjustments that ought to be made for this particular period.



A. TEMPERATURE AND VENTILATION

If your trainees are physically active, working in groups or on individual assignments, a room temperature of 68 degrees Fahrenheit is usually comfortable. Of course, a draft sweeping through the room or excessively dry air may cause discomfort at any temperature. Trainees who are sitting at their benches or work stations may need a higher room temperature for comfort.

Figure 99—Good lighting is essential

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When your shop or classroom is not equipped with automatic devices to control the temperature and ventilation, you can take care of the problem as you do in your own home—by opening or closing radiator valves, doors, and windows.

B. LIGHT

Much of our learning comes through our sense of sight. An instructor, then, should make sure that his trainees can see the work at benches or machines, or any writing on the blackboards. The room as a whole should have enough light so that illustrative material can be seen easily; and each work station should receive well-directed light so that the trainees need not work in their own shadow or strain to see their work.

Light should be directed so that the operator of each machine can see what he is doing. In Figure 99, daylight and artificial light provide good general illumination, but the operator of the machine in the center has neglected to turn on the light directly above his work.

Quantity of light at the proper places is only one aspect of the problem. Brilliant light may cause a glare from blackboards, walls, table tops, and shiny surfaces of machines. This glare irritates the eyes and prevents full concentration on the task at hand. To avoid glare, change the direction or intensity of the light; experiment by putting shades up or down and by switching on or off some of the electric lights. If this solution is impracticable, the trainees may move so that they view the offending surface from a different angle. Sometimes in the use of blackboards, glare can be reduced by using colored crayon, or pencils of contrasting colors.

After you have arranged for proper illumination of your shop or classroom in general, you can discover the need for minor adjustments by watching your trainees. If a trainee squints at his work, the trouble may be inadequate light or he may need glasses. If the trainees blink, find out if there is a glare on their work.

IV. SAFETY IN THE SHOP

Safety instruction is an important and ever-present part of your job. You cannot detach it from your regular teaching assignments, nor can you teach it in one lesson and then forget about it. To develop safety consciousness and safe work habits among your trainees, you must constantly emphasize safety practices in both shop and class work.

Safety consciousness is an attitude which your trainees must have. This frame of mind encourages a trainee to focus on the prevention of accidents. He should have safe work habits and an awareness of the hazards of handling machinery.

In your safety instruction, emphasize both the physical and the human elements. The physical elements can be stressed by frequently calling the trainees' attention to the dangers inherent in machines, materials, and processes. The human elements are more difficult to handle since they include such personal characteristics as carelessness, ignorance, physical and mental fatigue, and any other attitude or act of the trainee which invites injury. Nevertheless, there are many common-sense precautions which you, as an instructor, can practice and insist that your trainees observe. Once they develop safe working habits and a proper respect for the hazards of working with machines, you have established some control over the human elements that cause accidents.

A. TO AVOID FALLING

Concern for safety is one good reason for keeping the floor of your shop clean. Trainees are unlikely to trip and fall if they habitually put away their materials and hand tools instead of leaving them on the floor. They should also be encouraged to wipe up any oil and to remove the remaining grease by sprinkling salt or a grease-removing chemical on the slick spot. Falling on a slippery floor may throw a man into a machine in operation; or, if he is carrying a heavy weight, the strain of the fall may cause a hernia.

Poor overhead lighting on stairways or in the corners of your shop may cause an unnecessary fall. On the other hand, extension cords lying on the floor present a hazard in themselves. For example, if several trainees who are drilling for riveting are each equipped with an extension cord, the danger of falling is considerable. The best solution for this problem is the use of overhead electrical outlets so that drop light cords can be suspended from the ceiling near the places where they are to be used.

B. TO AVOID INJURY FROM MACHINES

Other sources of danger in the shop are unguarded and improperly adjusted machines. You are responsible for frequent inspection of machines in order that they may be kept in good running order. In addition, your trainees must be impressed with the hazards of each machine and with the safety devices or guards which prevent injury. They must be trained so carefully that they get into the habit of operating these machines as though the usual safety devices were not attached. Thorough understanding of the adjustments for each machine also helps the trainees to work safely.

For example, suppose you were in charge of several grinder stands. You inspect the wheels frequently for nicks or rough places which might cause pieces of metal to fly up into a trainee's face. These wheels must, of course, be equipped with guards or shields, but the

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trainees should not be taught to depend on them. They should work on the grinders as carefully as if the shields were not there. To avoid the danger of a bursting grinder wheel, they should know the speed at which any particular wheel should run before installing it on the machine. Goggles should be placed near the wheels so that the trainees become accustomed to using them for the protection of their eyes.

Figure 100—See that trainees wear appropriate clothing

A machine may injure a trainee if he is improperly dressed for work. Figure 100 shows what the "well dressed" mechanic should wear when working on a surface grinder. At the top of the same picture, notice the shield over the wheel.

Good light at the machines helps the trainees to be careful. They should be able to see their work clearly if they are to avoid injury to their hands when they are using such machines as drill presses, punch presses, and lathes. For this purpose, a small direct light may be necessary in addition to the overhead illumination of the room.

Some machines produce dangerous gases and fumes which must be cleared from the shop. Sometimes the ventilating system automatically takes care of this problem. If not, you may need to improvise a blower, and then make sure that it is turned on whenever the machine is in operation.

C. TO AVOID INJURY FROM TOOLS

Accidents often happen when trainees are working with ordinary hand tools. The trainees may not handle the tools carefully, or the tools may be in poor condition. In either case, the instructor is in part responsible for any injury. Without question, teaching the trainees to handle tools properly promotes safety in the shop. Careless handling of a knife or chisel may result in a cut which would hamper the trainee's work. When grinding, soldering, or chipping, the trainee should be in the habit of wearing goggles to protect his eyes from flying metal.

Careful and fairly frequent inspection of the tools is necessary if they are to be kept in working condition at all times. Worn, dull, and unadjusted tools should be removed from the tool crib or work benches until they can be put into good condition. Battered cold chisels and star drills are unsafe tools in the hands of any mechanic. Figure 101 shows a tool board with the tools in good condition.

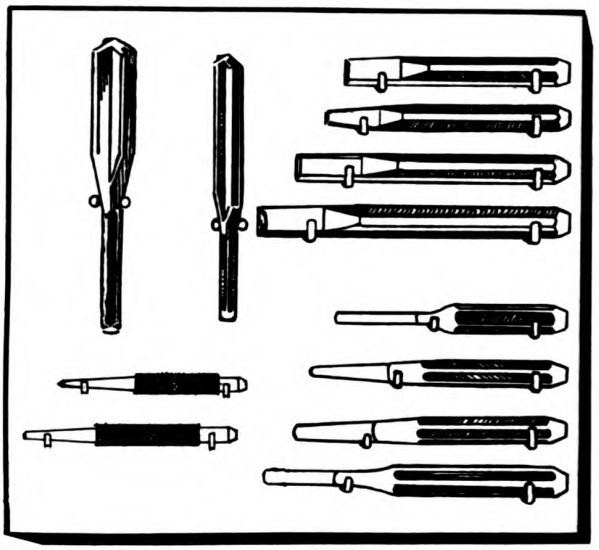

Figure 101—Keep tools in good condition

Trainees must also beware of heavy objects about the shop which may fall from above them. For instance, unless they are warned, they are likely to put tools on top of cabinets or lockers. Suppose a trainee put a heavy wrench on top of his locker, and the door sticks so that there is considerable vibration when he attempts to open it. There is a good chance that he may receive a severe head injury from the wrench as it falls over the side.

D. TO PREVENT FIRE

You and the trainees must co-operate to avoid the hazards of fire. While you are primarily responsible, everyone in the shop must be alert to conditions that cause or intensify fires.

Getting rid of gases and fumes is not only important to the health of the workers, but it may prevent an explosion and the resultant fire. Explosions and fire may also come from careless use of chemicals and inflammable solutions. Oily waste and greasy rags should be taken from the shop and disposed of properly. Do not allow them to be thrown on a heap in the corner of the shop, or they may cause spontaneous combustion. Greasy cloths which are in use should be spread out when the shop is closed at night.

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Trainees can usually avoid burns if they understand safe ways of handling and using chemicals, steam, hot metals and inflammable solutions. An understanding of the dangers of faulty electric wiring helps them to avoid shocks and possible burns. Although you should check the electrical equipment regularly, the trainees should be encouraged to report any exposed conductors of electricity. The responsibility of reporting to you may prevent an inquisitive or uninformed trainee from receiving a severe shock or burn.

E. TO KEEP THE TRAINEES ALERT ABOUT SAFETY

Good workmen are not careless. Trainees whose safety education accompanies their daily work in the shop are in the habit of working carefully. In addition, an instructor should seize every opportunity to make them aware of the importance of safety practices.

The chief causes of accidents traceable to the individual trainee are his ignorance of safety rules and the wrong attitude toward safety precautions. Also, long periods of work without a rest period will bring on fatigue and lessen the individual's ability to guard against carelessness.

Yours is the responsibility of acquainting the trainee with the safety rules of your trade, insisting on the observance of shop-safety precautions, and by your own acts setting before your trainees a model of safety consciousness.

You cannot overemphasize the importance of safety rules and practices. Whenever you demonstrate a new skill to be learned by your trainees, show them the safety precautions and give substantial reasons why such practices are necessary.

It is good practice to keep safety posters on your bulletin board. Since these posters are usually given away freely by insurance companies and safety committees, you can change the material often enough to hold the interest of the trainees.

In some shops, safety campaigns are a continuous part of the production and training programs. Some type of recognition may be given those departments with no-accident records. Where every trainee becomes a member of a safety team in competition with trainees in another department, the safety record is likely to improve. Competitive safety campaigns cut down the usual man-hours lost because of accidents and save the trainees the expense and discomfort of recuperating from injury.

Figure 102—Use safety posters

You should occasionally test your trainees for their understanding of safety practices and their observance of such practices. A written test is one means of checking on their knowledge and of emphasizing the importance of safety practices. If an accident does occur, several of these written tests may protect you against the accusation that safety practices were never taught as a part of your course.

V. HUMAN RELATIONS

Getting along with your supervisor, with other instructors, and with your trainees has much to do with your success as an instructor at the depot. Your supervisor and fellow instructors have a right to expect that you will be loyal and co-operative. All of you will be working together toward a smoothly operating training program. When problems arise, you may ask your supervisor for advice, or suggest remedies, or work out a solution by yourself or in co-operation with the other instructors.

Your relations with your trainees will be more successful if you think of yourself as a leader rather than as a boss. The instructor who acts as boss issues orders and relies on his authority to back them up. The leader, on the other hand, directs and guides the trainees. They are persuaded to follow his suggestions because they respect his knowledge and skill, they share his enthusiasm, and they have respect for his judgment.

Since your trainees are mature, you cannot treat them as children without arousing their resentment. Treat them as grown-ups and equals. Allow them as much freedom in your shop as you can without disturbances. To earn this freedom, the trainees should be conscientious in their work, and they should share the feeling of responsibility for the success of the training program.

In the following paragraphs are suggestions for developing a fine spirit of co-operation among your trainees.

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A. INDUCTION OF THE TRAINEES

Whether trainees arrive for instruction singly or in groups, their experiences in the first few days may determine their attitudes during the following weeks.

Greeting the trainee cordially is the first step in establishing good relations with him. If you talk with him for a few minutes, he will appreciate the chance to get acquainted with you. Then, explain carefully the purpose of the training and the nature of the job which follows it. Show him where he will work, and see to it that he meets his fellow trainees. Give him any needed directions firmly, so that he understands that you mean business.

These suggestions for inducting a single trainee can also be adapted to a group of trainees. The first few minutes of the instructional period should make the trainees feel welcome. You should begin immediately to learn their names; and writing your own name on the blackboard is a good way of helping them learn yours correctly. The nature of the training and the job can be explained in detail to a group of trainees because they usually ask good questions which honestly reflect their interest and worries.

B. BUILD THE TRAINEES' CONFIDENCE IN YOU

If the trainees' first impression of you is good, it is not hard to build up their confidence. Every day, your contact with each one should convince him that you are interested in his progress and in him as an individual. Your encouragement means much to him. Even though the quality of his work may not be up to standard, you can commend him for trying to improve. Praise for any trainee, however, should also stimulate him to greater effort. You can keep him from being satisfied with his present accomplishment by enthusiastically showing him the next step he must master.

Although it is well for you to know something about the interests of each trainee, you must never betray anything that he has told you in confidence. As a matter of fact, you are wise not to discuss his work or his interests with other trainees, since you can be almost certain that your words, or sometimes an inaccurate rewording of your remarks, will go back to him.

Keep in mind the necessity for building confidence among *all* the trainees. Make it apparent that you are equally interested in all of them. Because some trainees learn more rapidly or ask fewer questions than others, do not neglect them entirely. The less able trainee may be sensitive and shy about seeking your aid. You may have to discover his troubles by observing his work and by stopping to talk to him. At the same time, do not appear to like or dislike some trainees more than others. Avoid embarrassing any trainee by criticizing him in front of the group. On the whole, if you remember how you liked to be treated when you were a student, you will have little trouble in gaining the confidence of the trainees by your considerate treatment of them.

C. BUILDING ENTHUSIASM FOR THE TRAINING

Trainees who believe that their work is important are usually enthusiastic about their training. This feeling of deserved importance is based on their confidence in you and their interest in the work they are learning to do.

The best way to arouse the trainees' enthusiasm is to let them see that you are enthusiastic about the job you are teaching them to do. They are likely to share your belief if you tell them why you think that their job is interesting and important. For example, learning the routine details of depot supply work can be dull unless the trainee sees clearly the connection between his job and the whole problem of supplying the armed forces for battle.

When a trainee's interest in his work lags, you can arouse it again in a number of little ways. For instance, he may feel more useful if you ask him to help another trainee, to help you, or to do a job requiring special skill. Also, he may be stimulated in his effort if he is told where he stands in his group.

When he feels that he is an important member of a team, that he is needed, and that you depend on him, he is likely to work hard. His enthusiasm mounts with every evidence that he is useful and that his work is important.

D. THE REPRIMAND

In spite of all your efforts to be fair, friendly, and encouraging, things occasionally go wrong. For example, a trainee may make trouble by refusing to do his work, by interfering with the work of others, or by being habitually careless in his work. When you must show your disapproval, do it in such a way that he is anxious to improve. Never "bawl him out" angrily in public. You are likely to take unfair advantage of your authority in such a situation, and the trainee becomes resentful and discouraged.

A careful reprimand may not only prevent the trainee from causing further trouble, but it also may change his attitude toward training in general. A good instructor frequently gives a troublemaker so constructive a reprimand that he becomes eager to co-operate and to assist the instructor in any way he can. To achieve this happy result, you must arrange to speak to the trainee in private and try to put him at his ease with a little ordinary conversation. Begin by asking him why he has done a certain thing. If he has a legitimate explanation, it may prevent you from dealing with him too severely and may prevent him from thinking that you are unjust. Usually, however, you must follow through with the reprimand. Don't mince words with him; talk to him directly. Explain exactly what was wrong with his action, why it was wrong, and what he should do to improve. Tell him you have confidence in his ability to correct his attitude, and that you will help in any way that you can. If necessary, talk to him about other things so that he can see that you do not hold a grudge against him. At the end,

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not only should he feel that you will hold him firmly to the required standard, but also he should be encouraged and eager to improve.

E. GRIEVANCES

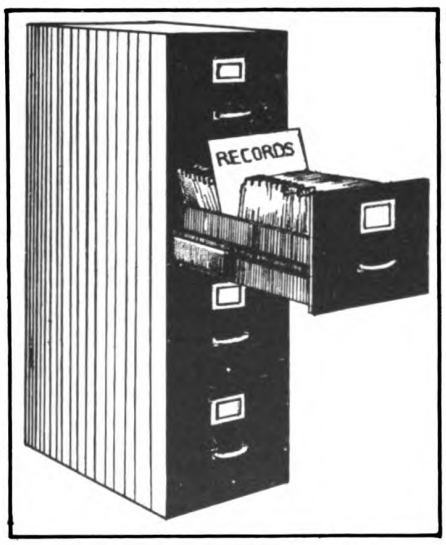
Trainees, like everyone else, may have grievances. In general, these grievances seem less important to the trainees if you have won their co-operation according to the foregoing suggestions. But some complaints will be made, and your method of handling them is important.

Some grievances are real; others are imagined. They may concern all of the trainees, a small group, or only one trainee. Your first duty is to listen carefully, to make sure you understand exactly what they are objecting to. Next, you must get all of the facts connected with the problem. If you have the authority to deal with the problem, you may then reach a fair decision based upon these facts. Otherwise, get a decision from the proper authority after carefully presenting the grievance, the additional facts you have discovered, your idea of its relation to the training program, and, possibly, a recommendation for a solution. Inform the trainees of the decision promptly; and give the reason for any adverse decision.

This businesslike method of handling grievances commands the respect of your trainees and wins the confidence of your superiors. While it does not encourage faultfinding, the trainees feel assured of a fair hearing.

VI. RECORDS AND FORMS

Any well-organized training program requires records and forms. Some of them give a permanent picture of the trainee's experience and progress. Others record the issuance of supplies, the inventories of supplies on hand, and the receiving and shipping of materials.



Although some of these records do not concern your work at all, there are many to which you occasionally refer in some centrally located file. The Personnel Department keeps individual trainee records for which you furnish information from time to time. The time cards of the trainees are handled in another department. The tool crib clerk may ask you to fill out forms for supplies used in your department. Other departments may ask you for information or may ask you to use certain forms in dealing with them. All of these records are necessary to prevent confusion in a complicated program.

The training officer or one of his assistants will tell you what information you are to record and how you are to record it. Your class record may be in a permanent binding or in a loose-leaf notebook. It will include a record of the names of the trainees, their attendance, their grades, and perhaps other remarks about their work. The more carefully you note the work of the trainees, the more valuable your records will be. Making up the final grade of each trainee is easier if you have a complete record. This final appraisal of each trainee is important because it becomes a permanent part of his service record at the depot, and may affect his search for employment after the war.

The progress chart (figure 103) has been approved for civilian training for Air Service Command. There are enough spaces for trainees' names so that late entrants may be added. The dates of beginning and completing the training should be carefully noted in the two right-hand columns. A trainee may be graded on each larger unit or block of work; and his final grade may be an average of all these unit grades. In arriving at a final grade, you may also consider the length of time the trainee took to do the sequence of jobs. Other spaces on the progress chart provide for such routine information as the name of the depot, the unit or branch within the depot in which the training is given, signatures of the instructors making the report, the name and number of the course.

Progress charts can be made up in any convenient size and form. They may be small enough to fit a class register or notebook, or large enough to serve as wall charts. The form remains the same although final grades may be omitted from wall progress charts. When used as wall charts, they offer several advantages worth considering. They give the trainee a picture of the total work to be covered, and they show him where he stands in relation to the other trainees. Used in this way, progress charts save the instructor from repeating the plans for the course and provide a constant incentive for the trainee to complete his work satisfactorily.

Progress charts are just as adaptable to classroom work as to shop work. Related subjects, such as blueprint reading, mathematics, science or trade theory, can be broken down into steps and arranged on a progress chart for training programs.

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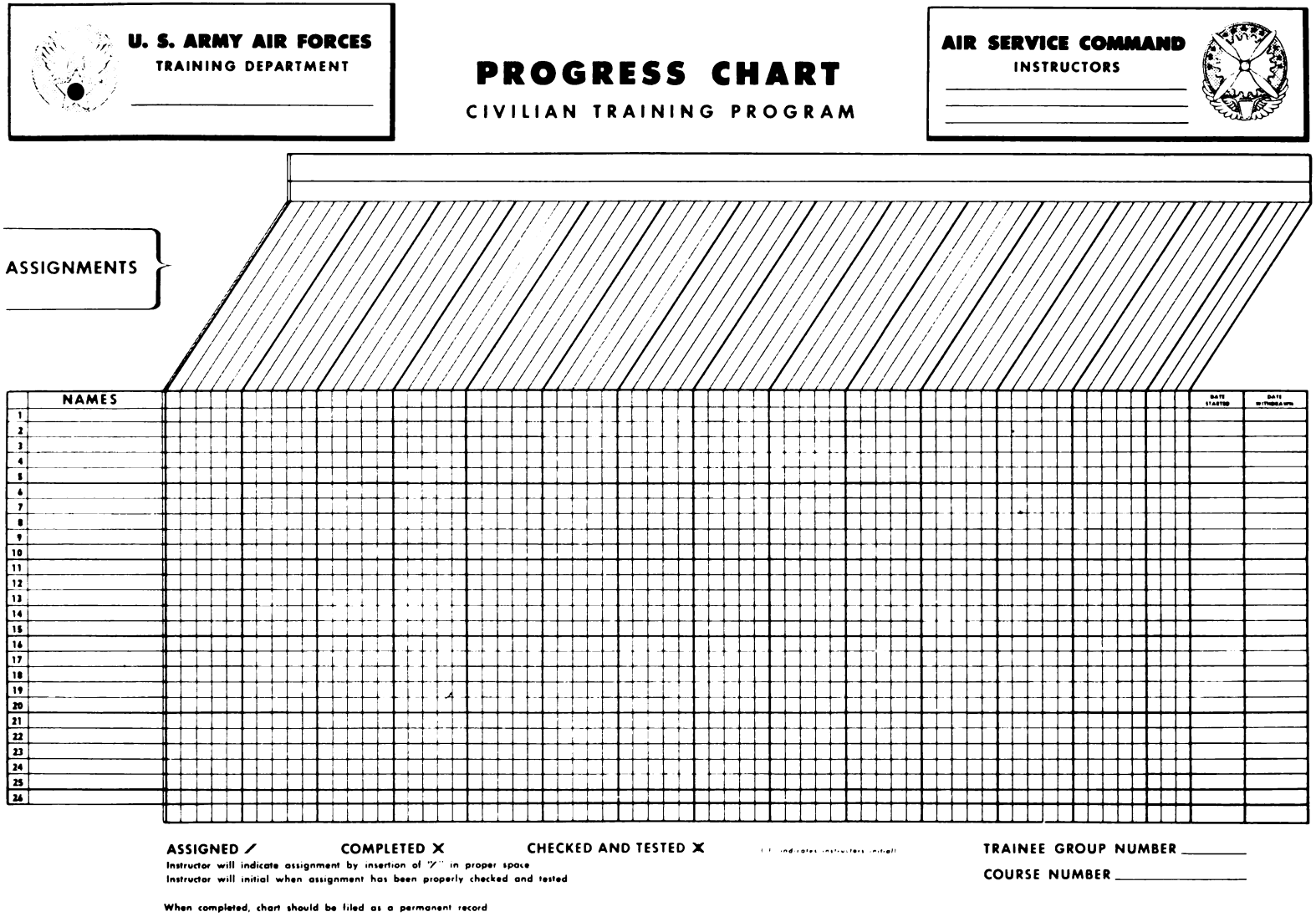

U. S. ARMY AIR FORCES
TRAINING DEPARTMENT

PROGRESS CHART
CIVILIAN TRAINING PROGRAM

AIR SERVICE COMMAND
INSTRUCTORS

ASSIGNMENTS

	NAMES	DATE STARTED	DATE WITHDRAWN
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			

ASSIGNED / COMPLETED X CHECKED AND TESTED X (I.I. indicates instructor's initial)

Instructor will indicate assignment by insertion of "/" in proper space
Instructor will initial when assignment has been properly checked and tested

When completed, chart should be filed as a permanent record

TRAINEE GROUP NUMBER _____
COURSE NUMBER _____

Figure 103—Progress chart

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Your primary responsibility, of course, is to keep careful records as recommended by your training officer. If there are no established forms, or if you wish to add to these records, you may be interested in two other forms that have been used in some of the depots.

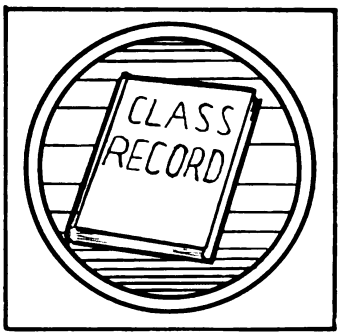
The daily attendance of your trainees may be put on the weekly record shown in Figure 104. In addition, there is space for grades earned during the week by recitation, shop work, and quizzes. An average grade and remarks help you to decide later on the trainee's final rating.

A more complete picture of an individual trainee's work is given in the training rating chart shown in Figure 105 From this chart, foremen and shop superintendents can secure information about the trainee's personality traits and about his ability to do a particular job.

At the end of the training, you can fill out this chart as a summary of the work done by your trainees. The attendance record provides information for your first column after the name of each trainee. Your notes and memories of the trainee's personality help you to judge the traits listed. The final grades should be transferred from your record book. Additional comments should include your final estimate of the trainee's work—the sort of comment that would help you place him correctly if you were his employer.

The sample rating of John Green in Figure 105 shows the importance of observing your trainees thoughtfully, and the usefulness of a careful record of your observations.

Upon completion of a course, a trainee is usually given recognition of his work. Figure 106 shows a certificate of graduation signed by the officer in charge of training. On the back of this certificate (shown in Figure 107) is the instructor's record of the subjects completed, the hours of work in each course, and a general comment on the trainee's work.



QUESTIONS

(1) What safety practices were violated in the mismanaged bicycle shop described at the beginning of the chapter?

(2) Make a list of the more important supplies needed in your specialty. After each item, write notes about its proper storage, including any special conditions of temperature, the convenience of placing it near other materials or machines, and the best method of labeling it.

(3) What care should be given to the machines and tools under your supervision? How often do you plan to give each one a routine inspection?

WEEKLY CLASS RECORD

WEEK BEGINNING_____

COURSE_____ INSTRUCTOR_____

TRAINEE	ATTENDANCE						GRADES				REMARKS
	M	T	W	T	F	S	CLASS	SHOP	QUIZ	AVGE	

Figure 104—A weekly class record

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RATING AND RECORD BLANK

COURSE _____ INSTRUCTOR _____ DATE _____

Trainee	Days Attendance	Personality Traits: Adaptability	Leadership	Cooperation	Industry	Grades: Shop Work	Class Work	Final	Comments
John Green	65	A	B	B	A	A	B	A	Excellent carburetor man - does not work well in group.

A - Excellent
B - Above Average
C - Average
D - Below Average
F - Unsatisfactory

Figure 105—A summary rating and record blank

UNITED STATES ARMY AIR FORCES

Air Service Command

Training Department

This is to certify that _____ *has satisfactorily completed the specialized course of instruction for* _____

Dates of attendance from _____ *to* _____

_____
OFFICER IN CHARGE

Figure 106—Trainee certificate

SUBJECTS COMPLETED — Hrs.

SHOP TRAINING

RELATED INFORMATION

PERFORMANCE TEST

PRODUCTION WORK

Total Number Hours Earned

Instructor's Comment

Date _____ Instructor

Figure 107—Summary record on back of certificate

(4) Make a floor plan showing an ideal lay-out for a shop in which your specialty is taught.

(5) List the most important hazards in a shop where you are likely to teach. How would you emphasize them so that the trainees would develop safety consciousness?

(6) Give specific examples of situations likely to be found in your shop where proper lighting could reduce the danger to the trainees and increase their efficiency.

(7) Distinguish between a reprimand and a "bawling out."

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Chapter 11

MEASURING RESULTS

The instructor looks at various tests he can use to check the progress of his trainees.

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MEASURING THE RESULTS OF INSTRUCTION

No production plant would stay in business long unless it checked up on its product at successive stages in the production process and after final assembly. Similarly, no training program can be done well without frequent and effective check-up on what the trainees have learned. Industry has developed many devices and techniques for inspecting and testing its products. Similarly, the instructor has many devices and techniques that he can use to check his product. The good instructor knows these and how to use them. This chapter describes the more important ones and how they can be used.

I. PURPOSE OF TESTING

Most check-ups are made so that the instructor can find out how much the trainees have learned, and, consequently, how well the instructor has done his job. If the trainee has acquired the necessary information, skills, attitudes, and work habits, and has achieved these with a minimum of time and effort, the instructor has done a good job. Without check-ups, however, the instructor may not know what he is securing in the way of results.

These check-ups serve several purposes:

(1) To find out what each trainee has learned, and what the group, as a whole, has grasped satisfactorily.

(2) To stimulate learning and competition among the trainees.

(3) To review what has been taught, and to correct errors and misunderstandings.

(4) To find out when your instruction has been effective, and where your methods could be improved.

II. WAYS WE CHECK UP ON THE TRAINEE'S WORK

There are several ways of gaining insight into the learnings acquired by the trainee. You can watch him as he goes about his work in shop or classroom. You can question him. You can appraise the material he produces or the repair job he completes. You can give him written quizzes or examinations. You can give a performance test.

By watching a trainee at his work, you can tell whether he is clumsy or skillful in his use of tools and materials, whether he is slow or swift in learning a skill, whether he is likely to make a competent workman. At the same time, you can notice personal characteristics and attitudes, such as his appearance, his ability to co-operate, his interest, and the seriousness of his purpose.

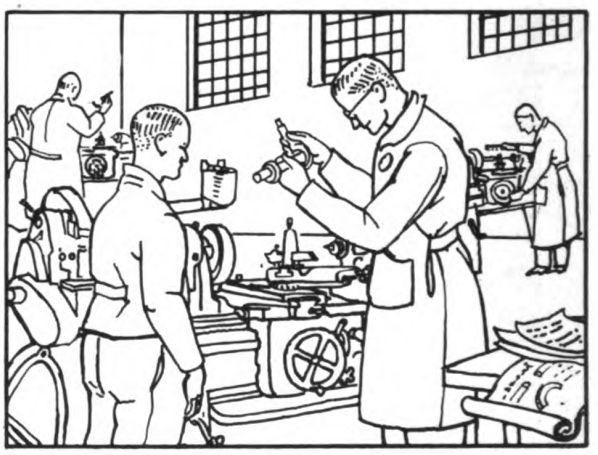

Figure 109—The instructor inspects trainee's work

Frequent inspection of the work of the trainee keeps you aware of his special abilities and weaknesses. He is interested in securing your approval, and listens carefully to your corrections of work he is doing or has just completed. A lathe operator, for instance, is unlikely to repeat a mistake in machining, if you check his work immediately.

Figure 108—The instructor observes trainees at work

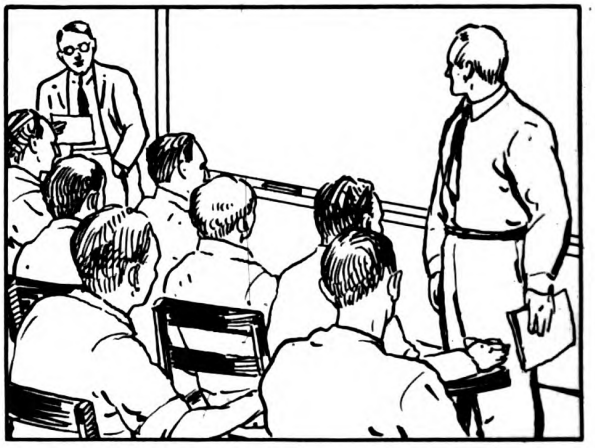

Figure 110—The instructor questions the trainee

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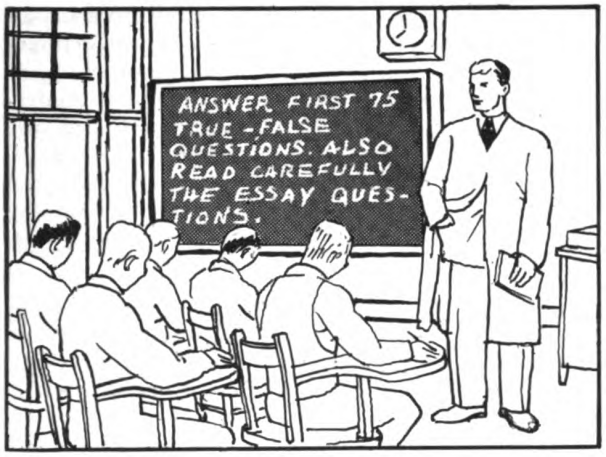

Figure 111—The instructor gives a written examination

You may also ask trainees questions in classroom discussions or in informal conversations at the workbench or desk. A trainee's answers to your questions may reveal not only his attitudes but also his knowledge about the subject matter of the course. You may uncover details about his difficulties and about his special abilities. For the trainee who has understanding but who lacks the ability to express himself clearly in writing, these informal methods of checking are useful and fair. They reveal the trainee's understanding and skill rather than his ability to remember isolated facts.

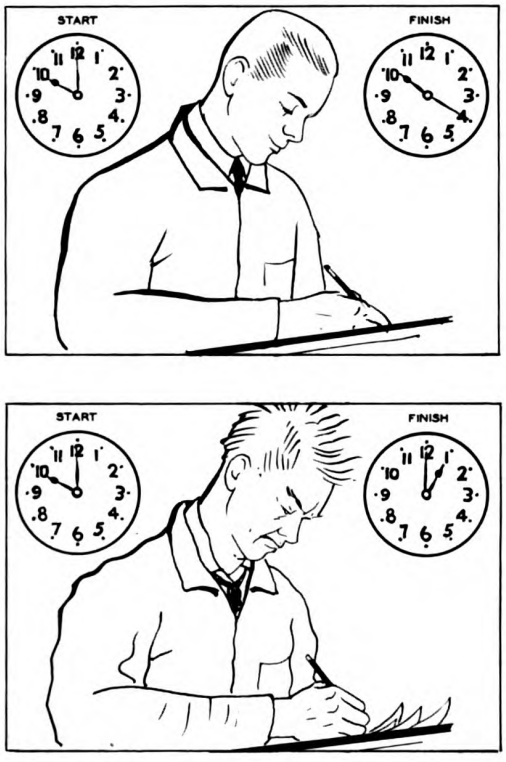

Figure 112—Make your tests as short as possible (2)

Giving written examinations is another way of investigating the trainees' knowledge and ability. Since a trainee's permanent record is likely to depend in part on his grades in examinations, it is very important that you prepare them thoughtfully. Your skill in making up these examinations will increase with the careful practice of the suggestions in this chapter. Examinations should test the trainee's ability, knowledge, and understanding—not simply his knack of memorizing notes and material from a textbook.

For the checking of shopwork, the performance test is often useful. You can give the trainee a special practical job as an overall check of what he has learned and then appraise carefully the work he turns out, the time he takes to do it, and the way he went about the job.

III. PREPARING TO CHECK THE RESULTS OF INSTRUCTION

Checking the results of instruction is very important and should be planned carefully. A good instructor does not usually decide at the last minute to give a test which he makes up hurriedly in a few minutes. Before writing an examination you should decide the length, scope, and type of test you intend to give. It must also fit into your schedule of instruction at a convenient time.

A. THE LENGTH OF THE TEST

Would a short written quiz do? In general, the test should be no longer than necessary to fulfill your purpose. In any situation, the test should be not so long as to tire the trainees, nor so brief as to have little meaning as a checking device. A three-hour written examination is unduly long. Twenty-minute tests are often adequate for your instruction. When you can give shop performance tests, be sure that they are not unduly long and tiring for the trainees.

B. THE SCOPE OF THE TEST

The test should properly cover all the important material that you have assigned or taught. Do not stress one phase while you slight other important points. You should never test the trainees about material you have neither assigned nor taught.

C. THE TYPE OF TEST

What kind of test are you going to give? Are you testing for skills or basic principles? Should the test be oral or written, short or comprehensive? Your choice of a satisfactory type of test depends upon your purpose in giving it.

The *performance test* is the best way of determining the trainees' ability to master skills or to complete an operation or whole job. If you cannot give a performance test for this purpose, you must then resort to giving written or oral tests.

You may use *oral questions* to test the trainees' preparation of the assignment, or to help them recall previously discussed information or basic principles. After their answers assure you that they understand the material, you can go on with the new learning.

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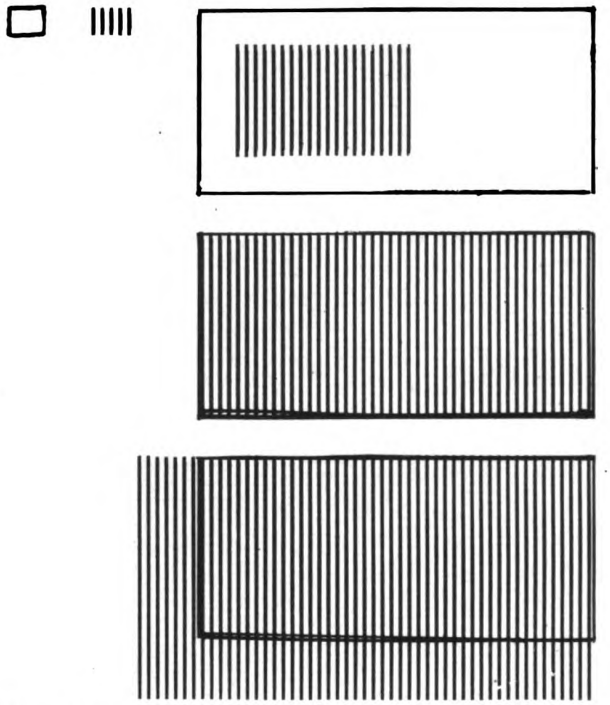

Figure 113—The test should cover the content of the course

Written tests can be adapted in length and make-up to suit many situations. Near the end of an instructional period, you may give a 5- to 15-minute written test of the *objective* type to determine the trainees' understanding and ability to apply the newly-learned material to practical problems. Whether your objective test is short or comprehensive, you should use a variety of objective questions. You may select any combination of *true-false, multiple choice, matching, completion,* or *identification questions.*

Longer written examinations, lasting for a period or more, are usually made up of objective questions and of some *discussion or essay questions.* These long tests are usually given after you complete an instructional unit or course.

D. THE TIME TO GIVE TESTS

You may give short oral or written tests in many of your shop or class meetings, particularly after you lecture or show a film. At the end of a week, a month, or a course, you may conduct a longer and more comprehensive examination. Whenever shop trainees have shown a reasonable mastery of a skill, you may give them a performance test.

WEEKLY SCHEDULE

	MON	TUE	WED	THU	FRI	SAT
8:00		✓				
9:00						
10:00			✓			
11:00	✓					
1:00				✓		
2:00		✓				
3:00			✓			
4:00					✓	

MONTHLY CALENDAR

SUN	MON	TUE	WED	THU	FRI	SAT
		(1)	2	3	(4)	5
6	7	8	9	10	11	12
13	14	(15)	16	17	(18)	19
20	21	22	23	24	25	26
27	28	29	30	(31)		

Figure 114—Schedule your tests

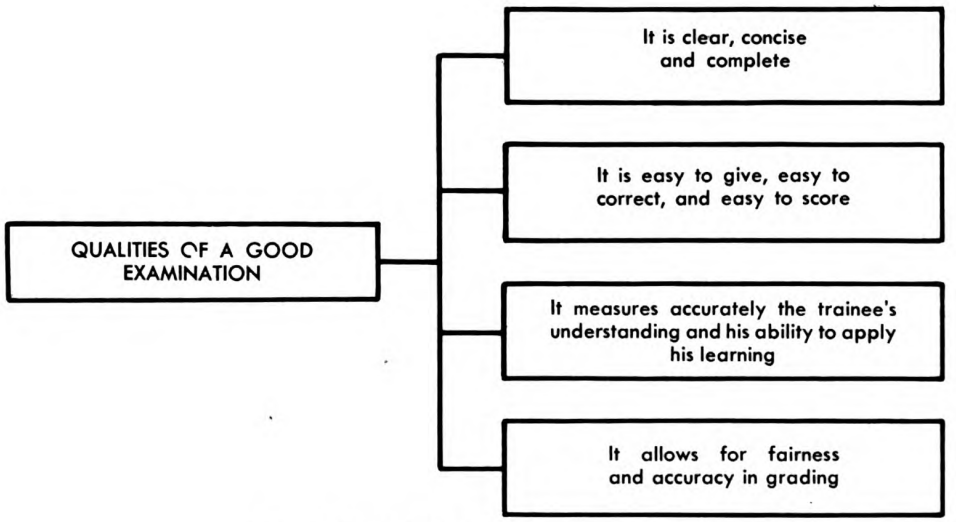

Figure 115—Qualities of a good examination

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IV. PERFORMANCE TESTS

The *performance test* is excellent for evaluating the quality or accuracy of a trainee's skills. It is not a paper and pencil test. Instead, it requires a trainee to apply skills he has learned to complete an operation with the very same tools and materials he would use as an employee. In this way, you can determine whether or not the trainee's skills are up to the standards of performance as established by the air depot.

A. ADVANTAGES OF THE PERFORMANCE TEST

(1) It shows the trainees' ability to apply skills and information they have been taught.

(2) It discourages bluffing by the trainees.

(3) It shows the particular weakness of each trainee and of the instruction.

(4) It can be scored with considerable accuracy, since each completed operation of a job can be judged by established standards.

B. DISADVANTAGES OF THE PERFORMANCE TEST

(1) It is difficult to prepare and to give.

(2) It takes the trainees considerable time to finish it.

(3) In scoring the finished job, it is difficult to determine how much credit should be subtracted from his final mark for the materials he has spoiled and the tools he has damaged.

C. HOW TO PREPARE A PERFORMANCE TEST IN RIVETING

Suppose you wanted to prepare a performance test of *accuracy in replacing rivets.* A good procedure is shown in the following steps:

(1) *First, list the operations* needed in replacing defective rivets. The list would include these points:

a. Drill the defective rivet head.

b. Remove the rivet.

c. Place the rivet set in rivet gun.

d. Insert the correct size and type of rivet.

e. Upset the rivet.

(2) *Next, list the tools and materials* needed for the test:

List of Tools

Portable electric drill	Rivet gage
Twist drills	Hammer
Buck-up bars	Pin punch
Rivet sets	Thickness gage
Pneumatic riveting hammer	Bench with vise

List of Materials

Small box of assorted rivets

Rivet test plate containing ten defective rivets

(3) *Now, prepare directions* for the trainees to follow in the test. Here is a sample of directions for the riveting test:

> Read the following directions carefully, and perform the operations necessary to complete the job in conformance with Air Depot Standards. You are to be rated by the results of the test to determine how ACCURATELY you can remove ten defective rivets and replace them with new rivets. The test plate, materials, and tools are now placed upon your bench.
>
> (1) YOU WILL REMOVE AND REPLACE TEN DEFECTIVE RIVETS WITH NEW ONES.
>
> (2) Do this job as ACCURATELY as you can.
>
> (3) Work at the speed best suited for you to do your best work.
>
> (4) After you begin your work, do not ask unnecessary questions.
>
> (5) Do not talk to your neighbors or borrow their tools.
>
> (6) Report all tool failures to your instructor.
>
> (7) Do not begin your work until the instructor gives the "go" signal.

(4) *In giving the performance test,* your part should be active and well-planned. To keep in mind what you are to do, you might jot down a set of directions for an instructor, as in the following list:

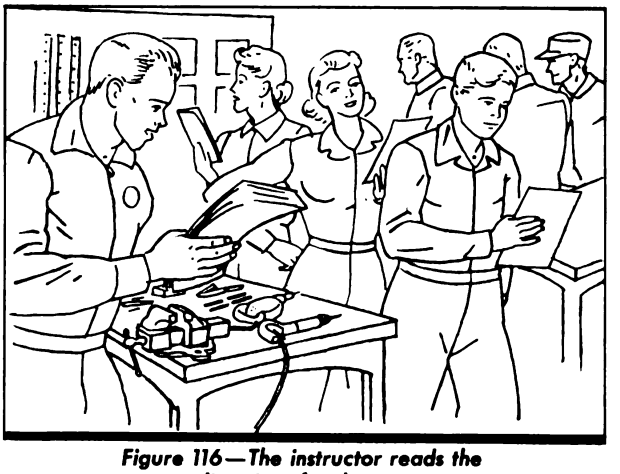

Figure 116—The instructor reads the directions for the test

a. At the beginning of the instructional period, read aloud the directions to the trainees while they read silently. Answer any trainee's questions about these directions.

b. Show the trainees a rivet test plate. Let them quickly examine their own rivet test plates.

c. Read the list of tools and materials each one should have on his bench. Have them check on their tools and materials at the same time. Ask them if they have all the necessary tools and materials.

d. If the trainees have no further questions, call them to attention and say, "Begin work."

e. After the trainees have begun work, walk about the room and notice whether or not they are doing the work in the correct order.

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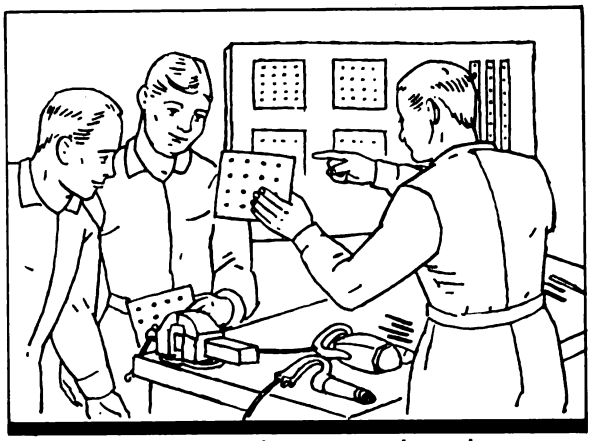

Figure 117—The instructor shows the trainees the test plate

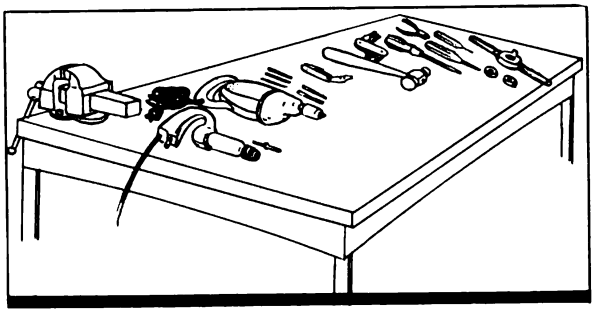

Figure 118—Tools for the test

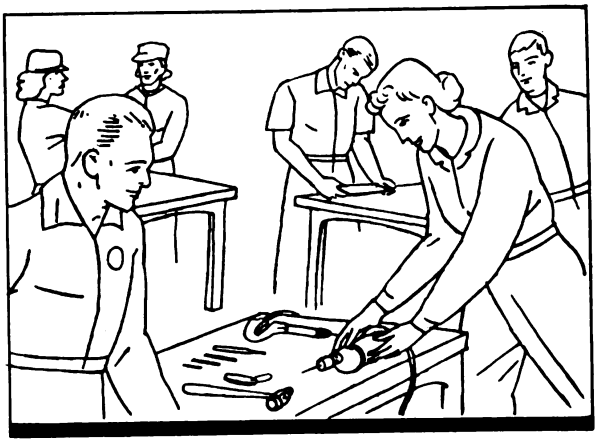

Figure 119—The trainee begins work

f. Observe whether or not they are using the proper tools, but do not tell any trainee how to use the tools.

g. Ask the trainees to hand in their test plates when they have finished their work. Do not hurry them. In this particular test, the emphasis is not on time or speed, but rather on the quality and accuracy of their work in removing defective rivets and in replacing them with new ones.

(5) *Finally, you score the performance* test on the basis of accepted standards. Here are important steps in scoring this test:

Figure 120—The instructor collects and examines the test plates

a. Riveting inspection standards are set up.

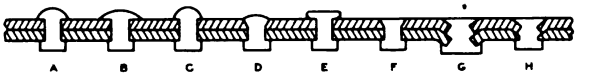

Figure 121—Good rivets

A. ROUND HEAD
B. BRAZIER HEAD
C. BUTTON HEAD
D. COUNTERSUNK OVAL HEAD
E. FLAT HEAD
F. COUNTERSUNK FLAT HEAD
G. PRESS COUNTERSUNK FLAT HEAD
H. COMBINATION PRESS AND MACHINE COUNTERSUNK FLAT HEAD

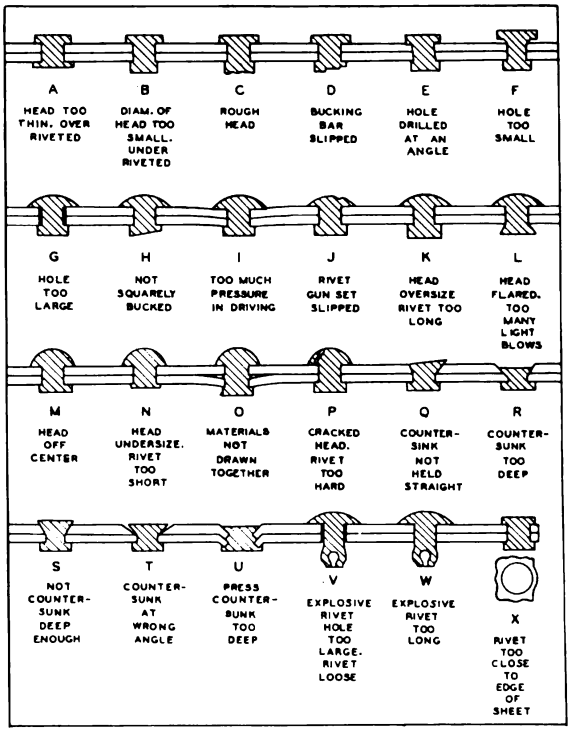

Figure 122—Poor rivets

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b. Check all replaced rivets with a rivet gage for correct height and diameter of the upset rivet end.

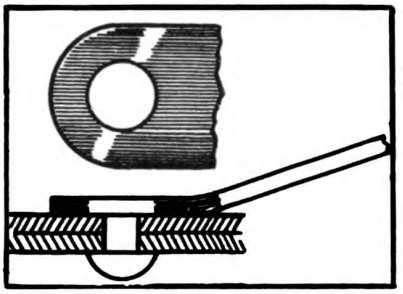

Figure 123—Checking with a rivet gage

c. With a straight edge or steel scale, check the manufactured rivet head of a countersunk rivet for flushness with the skin.

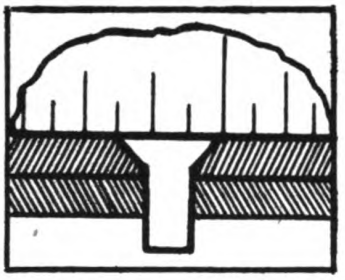

Figure 124—Checking for flushness with a steel scale

d. Inspect and check the manufactured rivet head of a brazier head rivet with a feeler gage.

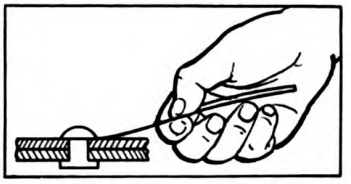

Figure 125—Checking with a feeler gage

e. Score the trainee's work on the basis of 80 per cent for a perfect test plate and 20 per cent for the correct use of tools and materials. Thus, if a trainee's test plate had four defective rivets but he had performed the operations correctly, his grade would be 68 per cent.

V. OBJECTIVE TESTS

The *objective examination* is an excellent paper and pencil test. It is easy to give and requires only a short time for the trainees to write the answers. The trainees answer the questions by writing symbols, numbers, words, or phrases. These brief answers can be checked quickly and easily with an answer key. This method of scoring reduces the need for personal judgment and permits more precise grading. Because the scoring is impartial, this kind of test is called *objective.*

Unlike the *essay examination* which covers only a few main points, the objective test usually covers a wider sampling of material, and, consequently, shows more accurately the range of the trainees' achievement. At the same time, it reveals the weakness of each trainee and of the instruction. It is much more difficult to prepare than an essay test, but it can become standardized and used again.

An objective test discourages the bluffing of a trainee who writes at great length but misses the point. On the other hand, such a test should not be used to test the ability of the trainee to organize ideas into a logical pattern.

A. TYPES OF OBJECTIVE QUESTIONS

(1) A *true-false* question is a statement which is either true or false. The trainee decides whether it is true or false and answers it by writing a plus sign if it is true, or a minus sign if it is false. Sometimes he is instructed to write the letter "T" for true, and the letter "F" for false.

Here is the beginning of a true-false test on riveting. The trainee has recorded the correct answers.

Instructions to the trainees: Read each statement carefully, and write in the blank a + if the statement is true, or a — if it is false.

(+) 1. The proper size rivet should protrude through the metal not more than one and one-half times its diameter.

(—) 2. Rivets of 17 ST alloy are stronger than those of 24 ST alloy.

(2) A *multiple choice* question tests the trainees' ability to select the *best answer* from a list of three, four, or five possible answers. The question itself consists of a question to be answered or a statement to be completed by one of the answers written below.

The instructions to the trainee, the first question, and the correct answers for *two multiple choice* tests are given in the following examples.

Instructions to the trainees: Read each statement carefully, select the answer which best completes or answers it, and circle the letter in front of the best answer.

1. When the propeller pulls the plane through the air, the tips of the blades tend to bend
   a. backward
   (*b.*) forward
   c. sideways
   d. one forward and one backward
   e. not at all

Instructions to the trainees: Indicate by a check (√) the answer you consider best.

1. Written matter may be sent by
   ___*a.* fourth class mail
   ___*b.* second class mail
   √ *c.* first class mail
   ___*d.* third class mail

(3) The *matching* question is often used to test the trainees' knowledge of relationships between items of information, or between tools and materials. Here is the beginning of a test in aircraft metal work.

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Instructions to the trainees: Match the two columns by writing the appropriate number in the space to which it applies.

1. Toughness
2. Elasticity
3. Malleability
4. Ductility
5. Hardness

(*4*) is the property of metal which permits it to be drawn or stretched, compressed, bent or twisted, without fracture.

(*1*) is the property of metal which permits it to stretch under tension without breaking or tearing.

(*2*) is the property of metal which permits it to return to its original form after having been subjected to any of the various stresses.

(*3*) is the property of metal which permits it to be rolled, bumped, or hammered.

Here is the beginning of a *matching test* in blueprint reading. The correct answers of the trainee are included in this copy.

Instructions to the trainees: Match the two columns by writing the appropriate number in the space to which it applies.

1. Hidden lines
2. Center lines
3. Lines to represent alternate positions
4. Cutting plane lines

(*4*) heavy broken lines made up of one long and two short dashes, alternately spaced.

(*3*) broken lines made up of long dashes.

(*2*) broken line made up of long and short dashes, alternately spaced.

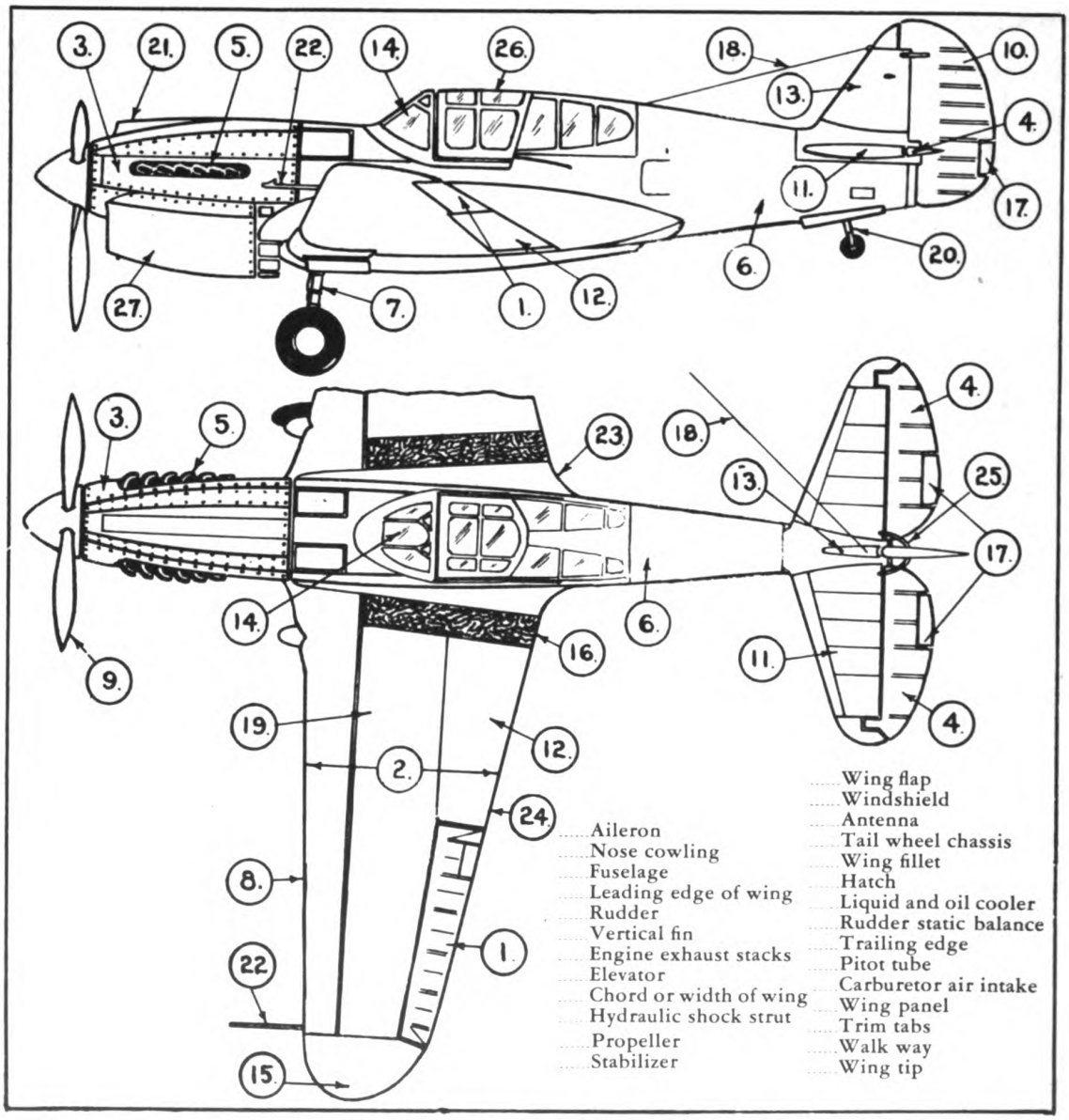

Figure 126—Identification test—Airplane nomenclature

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(4) A *completion* question requires the trainee to insert in the blank space provided, the appropriate word or phrase to finish the statement. In the following question, the correct answer, "30," is to be inserted in the blank space by the trainee.

> *Instruction to the trainees:* Supply the proper word or phrase in the following statements:
> 1. If a parachute is constantly worn but not used, it should be taken from its container, shaken out, and repacked at least once every ..... days.

(5) An *identification* test is easy to prepare and interesting for the trainees to take. Its purpose is to make sure that the trainee can recognize certain materials, instruments, tools, and defects as they appear in actual objects or in drawings, diagrams, or photographs. A sample of this type of objective test is shown at left.

Opposite the name of each part write the correct identification number.

B. PREPARATION OF OBJECTIVE QUESTIONS

Before you write questions of any kind, decide how much of the instructional material should be covered in the test. The following hints should help you prepare these tests efficiently:

(1) *True-false questions*

Begin by jotting down as many statements as you plan to use. About half of these should be true and half false. From 50 to 150 statements are usually necessary for an examination. Check these statements according to the following tests of a good true-false question:

a. Each statement contains *only one thought.*

b. It covers an *important point* and not an unimportant detail.

c. It is *definitely true or false.* Never use statements that are part true and part false. Avoid using "trick" or "catch" questions.

d. If making a statement false, *do not use the negative obviously,* or it may give away the answer.

Poor: Bending wire, rod, band iron, or seamed pieces will *not* ruin a sheet metal hand brake.

Better: It is a good practice to bend wire, rod, band iron, or seamed pieces in a sheet metal hand brake.

e. Avoid the use of the double negative which often confuses the trainees.

Poor: It is not impossible to feed material incorrectly in the squaring shears from the back.

Better: It is possible to feed material incorrectly in the squaring shears from the back.

f. Do not use words that give the trainees clues to the answers. The words "never" and "always" usually indicate false statements, while such words as "sometimes" or "usually" indicate a true statement.

Poor: Guards should always be in position before operating squaring shears.

Better: Guards should be in position befo.e operating squaring shears.

When you are satisfied with your statements, rearrange them with the simplest statements first and the more difficult toward the end of the test. Then, prepare written instructions for the test, so that any instructor giving the test can tell the trainees what to do. Finally, make a key by arranging the answer spaces in a column so that the scoring can be done easily. Here is an example of a key for scoring a true-false test.

Scoring Key	
1. +	1. + Stroke is the distance the piston travels from top dead center to bottom dead center.
2. —	2. — Bore is the length of the cylinder.
3. +	3. + Piston displacement is the area of the top of the piston in square inches multiplied by the distance the piston travels in one-half a crank shaft revolution.

(2) *Multiple choice questions*

In order to prepare a *multiple choice test,* jot down a series of statements to cover the material taught. Prepare five answers for each statement. *One* of the five answers is correct; the remaining four appear to be correct but are not. In the following example, all of the answers sound fairly reasonable because they are types of engines.

> An engine in which the cylinders and crank case revolve around a stationary crank shaft is called
> .....radial engine .....barrel engine
> .....inverted engine __√__ rotary engine
> .....opposed engine

The following suggestions should help in the preparation of multiple choice questions:

a. Avoid using grammatical constructions which may give a clue to the correct answer.

b. Avoid answers that are weak or that do not apply.

c. Vary the location of the correct answers so that the trainee does not try to figure out the likely answer.

(3) *Matching questions*

You will find the construction of *matching tests* fairly easy in certain instructional fields. There are, however, some simple rules which should be followed. The procedure is as follows:

a. For matching tests developed from statements dealing with such items as materials, processes, or principles.

1. Write down a series of statements concerning the item to be covered.

Example—Turbosuperchargers are operated by the engine exhaust gases.

2. Divide the subject and predicate of each sentence.

Example—Turbosuperchargers / are operated by engine exhaust gases.

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3. Arrange the subject and predicate parts of these sentences into two columns. Place a blank space ( )before each of the subjects. Place a number before each predicate. Mix up the order of the items so that most of the predicates are not opposite their respective subjects.

Example

(2) Aftercoolers	1. are operated by engine exhaust gases.
(3) Carburetors	2. are used for cooling the combustible mixture before it enters the cylinder.
(1) Turbosuperchargers	3. mix the gasoline and air to form a combustible mixture.
	4. are used for cooling the air before it enters the carburetor.

b. For matching tests developed from lists of related items.

1. Write out two lists of related items, such as tools and operations, with the tool and operation opposite each other. Mix up the order of the items so that most of them do not match the items opposite. Place a blank space before each item in the first column, and number each item in the second column.

Example

Tool	*Operation*
(2) Hacksaw	1. Enlarging holes.
(1) Reamer	2. Cutting off steel bars.
(4) Tap	3. Measuring angles.
(3) Protractor	4. Cutting internal threads.
(5) Screw pitch gage	5. Measuring threads per inch.
	6. Removing broken studs.

c. Some rules concerning matching questions.

1. Do not use too many items. More than twenty items often confuse the trainee and complicate the process of developing the test.

2. Make sure that only one correct combination can be made between items in the first list and those in the second. Go over every possible combination of items, and check to see that an item in one list can be used properly with only one item in the other list.

3. Include one more item in one list than in the other to eliminate guessing. It is usually desirable to include this extra item in the numbered list.

4. Mix up the items so that they are not in sequence as numbered, and so that most items are not opposite the corresponding ones.

(4) *Completion questions.*

In constructing a *completion test,* jot down a series of statements such as the following:

A.C. forms No. 104 are shipping tickets which are prepared by higher authority, ordering the transfer of both accountability and responsibility for material shipped from the consignor to the consignee.

For a completion question, omit a key word or key words from the statement, as follows:

A.C. forms No. 104 are ..... which are prepared by higher authority ordering the transfer of both accountability and responsibility for material shipped from the consignor to the consignee.

Here are the tests by which you can check your completion questions:

a. Be sure that the omitted words are the *only correct ones* that can be filled in by the trainees.

b. If you have *too many blanks* in one sentence, the meaning might not be clear to the trainee. For example:

A.C. ..... No. 104 ..... which are prepared by ..... ordering the ..... of both ..... and responsibility for ..... shipped from the ..... to ..... .

Omit only those words in the sentence that test the trainees' knowledge. Keep in mind the fact that you want to *test* them, not to prepare a puzzle for their entertainment.

c. Be sure to make all blanks the *same length.* Statements which include blanks of different lengths may give clues to the answers expected.

d. Do not use sentences taken directly from tests or technical manuals. This practice encourages trainees to answer from memory. You will also find few sentences in books that can be used without considerable change.

(5) *Identification tests*

Select a clear drawing or photograph of a mechanical unit, instrument, or set of tools, which has a number of distinct parts requiring accurate recognition. First, be sure that your drawing or photograph shows the parts clearly. Next, draw a line or arrow from each separate and important part to a number in the white space surrounding the picture. Beneath the drawing or on a separate sheet of paper, if necessary, the numbers should be listed in order and followed with a blank space where the trainee is to fill in the name of the part.

If an actual machine is available, you can mark or attach numbers to its parts. Then the trainee may put a list of the same numbers on his paper and the name of a part after each of the numbers.

Suppose you want to find out whether your trainees can identify tools. Usually, you can attach a large clear number to each tool and arrange the tools on a panel. Then, arrange corresponding numbers and blanks on the test paper which you give to the trainee.

Another way of giving this test would be to use numbered drawings or photographs, provided that each tool is shown clearly. At the bottom of the page, list the numbers of the tools followed by a blank in which the trainee can write the name of the tool. An example of this test is given below:

Sometimes you may want to have the trainees identify the parts, materials, defects, or symbols, by matching them with the correct answers. This procedure was used in figure 126, where the names of the parts

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of the airplane were to be matched with the numbers. You may use matching for identification under these two circumstances:

(1) If there are 20 or more identifications to be made, matching will shorten the time needed for the test.

(2) If more than one answer might be considered right or partly right, the matching will make the test easier to correct and more objective. For example, a problem in grading arises if a student writes "head" or "compression head" instead of "cylinder head." With the matching question there could be but one answer.

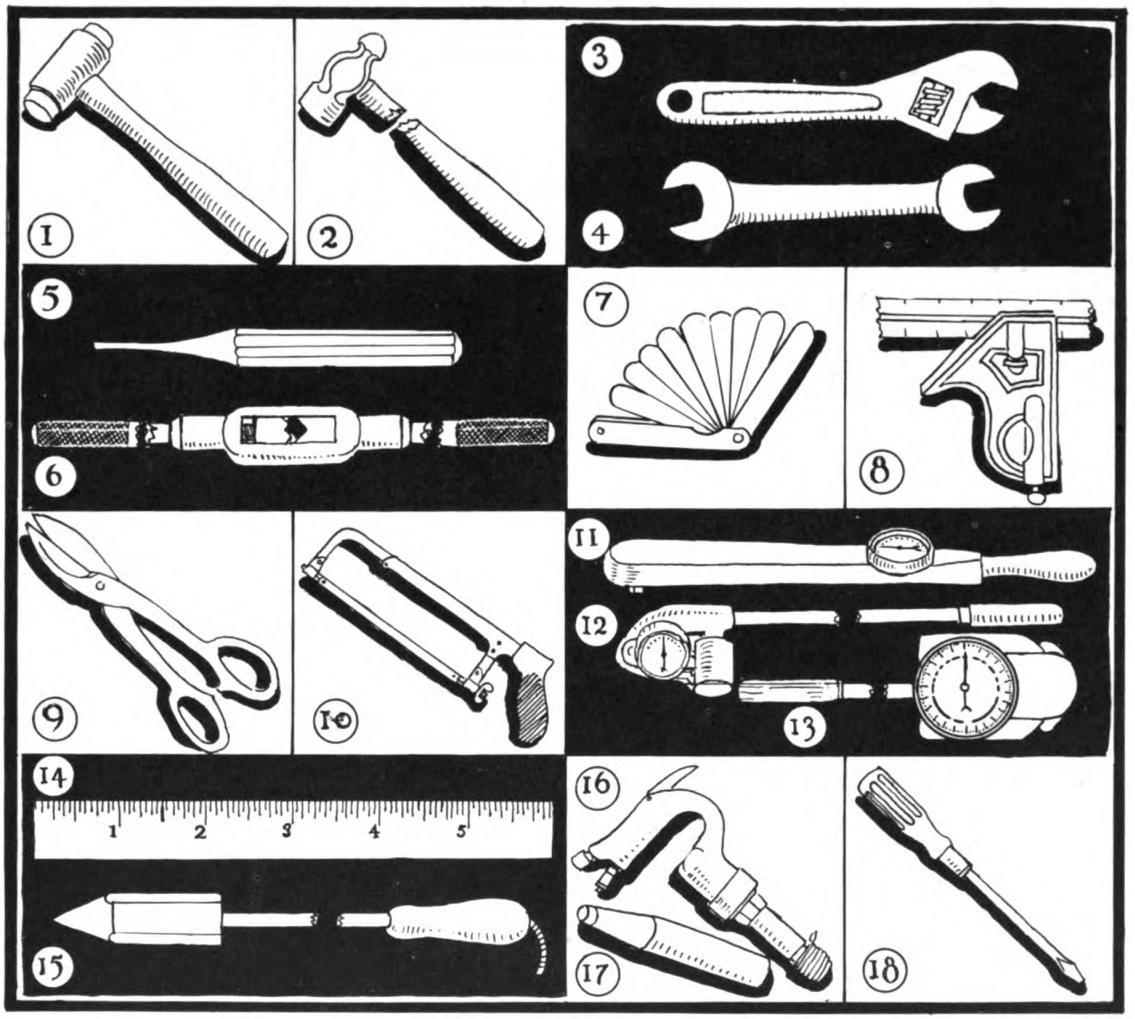

Figure 127—Identification test—Tools

1.....
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18.....

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VI. ESSAY TESTS

The *essay test* is a written examination in which the questions must be answered at considerable length. Here are some typical essay questions:

(1) Discuss the effect of improper spark plug gap clearance upon aircraft engine performance.

(2) Explain the purpose of the Hamilton standard constant speed propeller control unit.

(3) Discuss the advantages and disadvantages of the two-speed internal gear driven supercharger.

Each of these questions requires a detailed discussion if it is to be answered fully.

A. ADVANTAGES OF ESSAY QUESTIONS

(1) They are adaptable to many subjects.

(2) They are better for instruction dealing with *ideas* than for instruction dealing with *skills.*

(3) They provoke considerable thought on the part of the trainee if they are skillfully constructed.

B. DISADVANTAGES OF ESSAY QUESTIONS

(1) They can usually cover only the principal sections of an instructional unit.

(2) The answers require a long time for writing, reading, and scoring.

(3) Accurate scoring and fair grading are very difficult because the instructor is likely to be influenced by factors other than the correctness, such as

a. neatness and arrangement of test paper.

b. the length of the answers.

c. the trainee's literary ability.

d. the trainee's former class records.

C. PREPARATION OF ESSAY QUESTIONS

Essay questions are fairly easy to make up. If you have any trouble getting started, try beginning with one of the following:

1. Why
2. Define
3. Explain
4. Discuss
5. Compare
6. Classify
7. Criticize
8. Interpret
9. Outline
10. Show the significance
11. Give the reasons for
12. Indicate the relative importance of

To make sure that your essay questions are as good as you can make them, check them by the following suggestions:

(1) Make the questions short, direct, and specific.

(2) Do not use unnecessary words or phrases.

(3) Avoid using negatives or double negatives.

(4) Word the question so that its meaning is unmistakable.

(5) If a question involves several points, subdivide it.

(6) Word your questions so as to require answers that test the trainees' understanding rather than their memory of text or lecture phrases.

(7) Bring important questions to the trainees' attention or assign special weight to those questions.

VII. GRADING

A. WHAT IS A GRADE?

A *grade* is your estimate of the trainee's mastery and understanding of the material taught in part or all of the course. It often represents your appraisal of his work in a single test on part of the instructional material, or in a comprehensive examination at the end of the course. In either case, it is based on the number of questions which a trainee answers to your satisfaction in a test or examination. At other times, a grade is your estimate of the trainee's ability after you have observed him at work, after you have inspected his finished work, or after you have questioned him informally. A *course grade* or a *final grade* summarizes or averages all of his work in the course.

B. HOW ARE GRADES USED?

(1) Grades stimulate trainees to improve in their efforts to excel their classmates' records or their own previous records.

(2) Grades indicate whether the trainee is more capable or less capable than others in the class.

(3) Grades provide a basis for giving the more capable trainees advanced work, or for promoting them, or for advising that they become specialists in the field of their particular ability.

(4) Grades may provide some evidence that incompetent trainees should be required to show considerable improvement or be transferred to work for which they show aptitude.

NAME	REC.	SHOP WORK	EXAM	FINAL
Y.R. Rattlesnum	97	83	95	92
N.O. Remeal	66	95	50	70
Y.E. Nardbrah	85	83	87	85

NAME	REC.	SHOP WORK	EXAM	FINAL
Y.R. Rattlesnum	A	B	A	A
N.O. Remeal	D	A	F	C
Y.E. Nardbrah	B	B	B	B

Figure 128—Two kinds of grades

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C. HOW TO GRADE OBJECTIVE TESTS

(1) *Check*

In *constructing* these tests, you have already set up the standards for the answers. Assemble the correct answers on scoring keys so that you can check the papers easily.

(2) *Score*

In *scoring* a test of 100 questions, the correct answer to each question is usually worth one point. You may score a true-false test in either of these two ways:

a. The *easiest way* to get the score of true-false questions is by adding the number of correct answers. If a student answers 75 questions correctly, his score is 75.

b. If you want to discourage guessing by the trainees, subtract the total number of incorrect answers from the total number of correct answers. If a trainee answers 75 questions correctly, omits 10 answers, and answers 15 questions incorrectly, his score is 75 minus 15, or 60. There is a greater penalty for each incorrect answer than there is for the one that the trainee acknowledged he did not know, by omitting the answer. The "*a* method" is usually preferred.

Matching, multiple-choice, and completion tests are also scored by adding the number of correct answers. If one matching question is much more important or has many more parts to it, you can weight it by adding points to it; for instance, it might be worth five points instead of one point. However, when this is done you should inform the trainee of the weight of each question before he writes the test.

(3) *Grade*

When you have the scores, you are then ready to make up the *grades*. Below are several accepted systems of grades based on letters, numbers, descriptive words, and percentages, which are used to designate quality of work.

Letters	Numbers	Percentage	Descriptive Names
A	1	90-100	Excellent
B	2	80-89	Above Average
C	3	70-79	Average
D	4	60-69	Below Average
F	5	0-59	Unsatisfactory

Use the grading system accepted at your depot. Each of the five grades above represents the same value. Turning the scores into grades usually depends upon the relationship between the number right and the number wrong. For example, suppose you have a test in which the total possible score is 100 points.

If the trainee answers almost all or over 90 percent of the questions correctly, his grade will be *(A), (1),* or *Excellent.*
If he correctly answers 80 percent to 90 percent of the test, his grade will be *(B), (2)* or *Above Average.*
If he correctly answers between 70 percent and 80 percent of the test, his grade will be *(C), (3)* or *Average.*
If he correctly answers 60 percent to 70 percent of the questions, his grade will be *(D), (4)* or *Below Average.*
Certainly under ordinary circumstances, if a trainee fails to answer 50 percent to 60 percent of the examination questions correctly, his grade should be *(F), (5)* or *Unsatisfactory.*

D. HOW TO GRADE ESSAY TESTS

(1) Decide which points you expect to have covered in each answer.

(2) Decide which questions are most important, and what the point value of each one is. For instance, if there are five questions, one may be much longer, more difficult, or more important than the others. You could then assign it a total of 40 points instead of 10 or 15 or 20. (This can be done only if the trainee is informed of these values before he writes the test.)

(3) To make grading easier, open all test papers to the first question, and score that one question on each paper before continuing to the second question. Then, score the answers to the second question on each paper.

(4) After you have scored all the questions, add up the total number of points on each paper. Turn this score into a grade in the same way as you would the score of an objective test, as shown above.

E. HOW TO GRADE TESTS MADE UP OF OBJECTIVE-TYPE AND ESSAY-TYPE QUESTIONS

Decide on the weight for each section of the examination. For example, the objective part might be assigned 75 points, and the essay part 25 points. In that case, you could add the total score of each and then turn the final score into a grade, as suggested above in the discussion of objective grades.

F. GENERAL SUGGESTIONS ABOUT GRADING

(1) Remember that no single examination will reveal a trainee's true merit, for he may be ill or worried or unprepared at the time of taking the examination. But the average grade of a number of tests is likely to give a fair picture of his ability.

(2) Whenever possible, evaluate the trainee's performance in terms of trade standards. Otherwise, set up your own standards and keep them clearly in mind while scoring.

(3) In addition to the grade on each paper, you should write a critical comment on the good points and particular weaknesses of it. Or, you may include such comments in a personal conference with the trainee. If the errors are made by many trainees, you may have a profitable class discussion in order to clear up misunderstandings of subject matter.

(4) You will want to earn the reputation of being a *fair* marker, not an easy or a hard marker. In order to do that, notice the general trend of your grades. If they are characteristically very high or very low, construct your tests and weight your grades so that more of the trainees are doing average work than good or poor work. It is sometimes desirable to grade a trifle leniently at first in order that trainees should not be discouraged, and to set higher standards as they gain in skill.

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VIII. MEASUREMENT OF PERSONAL CHARACTERISTICS

As a good teacher, you will be interested in the personal characteristics of the trainee, as well as his ability to do the job, for you understand that his future supervisor will want to know what sort of person he is. Will he fit into the unit, branch, department, or organization? Is he co-operative? Does he have initiative and interest?

The answers to these questions will affect his placement, employability, and advancement. Collecting this valuable information is one of your jobs even though these characteristics do not affect the trainee's ability to produce.

While you can pick up some information about personality by casual observation, you can be more efficient if you use a rating scale for personal characteristics.

A. ADVANTAGES OF A PERSONAL CHARACTERISTIC RATING SCALE

(1) It furnishes a continuous written record of the trainee's personal characteristics.

(2) Trait-rating encourages the instructor to understand the trainee better.

(3) It gives the employer a better understanding of special cases, such as a superior trainee who is doing poor shop work, or a below-the-average trainee who is doing superior shop work.

(4) Ratings need not be made often since a trainee's personal characteristics change very slowly. Three or four ratings during an instructional course are enough.

B. DISADVANTAGES OF PERSONAL CHARACTERISTIC RATING SHEETS

(1) They are difficult to prepare.

(2) They usually cover only a few characteristics to be observed during a limited period of time.

(3) Fair and accurate rating is very difficult because the instructor is often influenced by such factors as:

a. Trainee's quality of voice
b. Trainee's ability to express himself
c. His liking for the trainee or his dislike for him
d. Trainee's former personnel records
e. Trainee's relationships or connections
f. Trainee's appearance or dress
g. Trainee's dislike of or indifference toward the instructor

(4) Standards are difficult to establish for the rating sheets.

(5) They are difficult to score.

C. HOW TO PREPARE PERSONAL CHARACTERISTIC RATING SCALES

(1) Make a careful analysis of the traits or personal characteristics that are desirable. A further collection of these traits may be based upon the observation and experiences of the instructor, conferences with other instructors, conferences with foremen and supervisors, and conferences with administrative officers.

(2) Use the pooled judgment of the instructors, foremen, supervisors, and administrators, before making your final list of character traits for the rating scale.

(3) Select only those traits that can be observed by the instructor in the classroom or shop.

(4) The traits selected should be of practical value to the employer.

(5) Let us assume that the two personality traits given below were selected by you, the shop foremen, the supervisors, and the administration. You list and define these traits in terms that are understandable and easy to observe:

Co-operation is the trainee's willingness and readiness to assist others when they need help, and to join in group undertakings.

Industry is the characteristic of a trainee who does careful, thoughtful work without wasting time and without constant supervision.

(6) After you have finally selected and defined the character traits, place them in a *rating scale.* A sample rating scale is shown in figure 129.

RATING SCALE OF PERSONAL CHARACTERISTICS

TRAINEE _____ COURSE _____
INSTRUCTOR _____ DATE _____

PERSONAL CHARACTERISTICS	RATINGS												
	FIRST				SECOND				THIRD				FINAL
	EXCELLENT	GOOD	FAIR	POOR	EXCELLENT	GOOD	FAIR	POOR	EXCELLENT	GOOD	FAIR	POOR	
LEADERSHIP													
COOPERATION													
INDUSTRY													
DEPENDABILITY													

Figure 129—Rating scale

QUESTIONS

(1) Make up a list of informal questions you might ask a trainee to test his *understanding* of some important principle.

(2) What points do you check when you observe your trainees at work?

(3) Make up 10 true-false questions that would reveal whether or not the trainees had read a short assignment in a text or Technical Order.

(4) Make up two *multiple choice questions* to test the trainees' understanding of a principle or of an operation important in your specialty.

(5) Devise a *performance test* for one important unit of your course.

(6) Write a *matching question* that will be useful in your instruction.

(7) Write two *completion questions.* Be sure that only one answer is possible for each blank.

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Chapter 12

APPRAISAL OF THE INSTRUCTOR

The instructor looks at himself and his work through the eyes of his supervisor and of his trainees.

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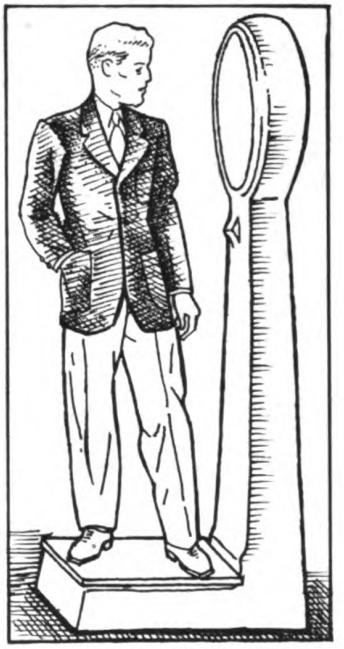
APPRAISAL OF THE INSTRUCTOR



While you are testing and rating your trainees, it is likely that your work as an instructor is also being appraised. How you rate depends upon your application of the fundamental principles of learning and teaching, your personal characteristics, and your knowledge of your trade or specialty. Many supervisors keep lists of these points for their convenience in rating instructors quickly. Whether or not your supervisor uses a form similar to the one reproduced in this chapter, he is likely to be concerned with the points contained in it.

The *rating chart* shown below contains some of the more important points on which the instructor should check himself. Many other points might be added. Check your work as an instructor against this rating chart. If you are especially good with respect to a certain item, make a check mark in the first column. If you are especially weak, check the last column. If your work falls somewhere in between, check the second or third column. Be honest with yourself in this rating. Compare yourself with instructors you consider outstanding.

Summarize your check marks in each group of items. Find out why you are low in certain items. Take steps to improve your performance on these items. Only in this way will a chart of this sort be of any value to you.

I. INSTRUCTOR RATING CHART

PERSONAL CHARACTERISTICS	RATING High 1	2	3	Low 4
Does he show enthusiasm for his work?				
Is he careful of his personal appearance?				
Does he have a good command of English?				
Does he speak clearly?				
Does he change the quality and tone of his voice for emphasis?				
Does he stand erect?				
Does he make good use of gestures?				
Is he loyal to his organization?				
Does he avoid spreading rumors?				

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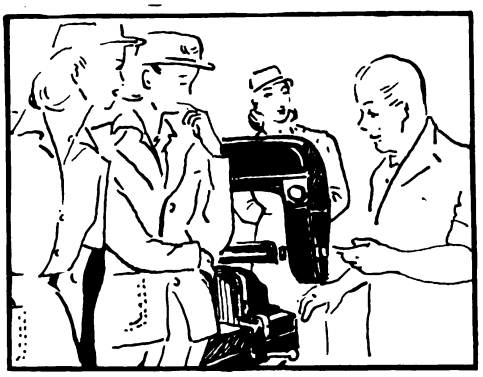

SKILL IN TEACHING

RATING

	High			Low
	1	2	3	4
Does he make adequate preparations for his lessons?				
Does each lesson have a definite objective?				
Does he break down the content into suitable teaching units?				
Is he skillful in arousing interest in the lesson?				
Does he explain the relation of each day's work to the whole job?				
Does he use good questions to review previous work?				
Does he use the best methods of presenting the new material?				
Does he tell, and show, and demonstrate or illustrate?				
Is he skillful in detecting and correcting the trainee's errors?				
Does he see that trainees get started doing things the right way?				
Does he insist that they always do things the right way?				
Does he require the trainees to practice until the right habit is established?				
Does he provide for individual differences among trainees?				
Does he evaluate trainees' work objectively?				
Does he insist that trainees do their own work?				
Does he provide opportunities for trainees to demonstrate their ability?				
Does he make good use of informal questions?				
Does he get at the root of trainee troubles?				
Is he skillful in handling troublesome trainees?				
Does he stick with his subject and not digress into other fields?				
Does he personally observe the rules of punctuality?				
Does he follow up his trainees after they have completed his course?				

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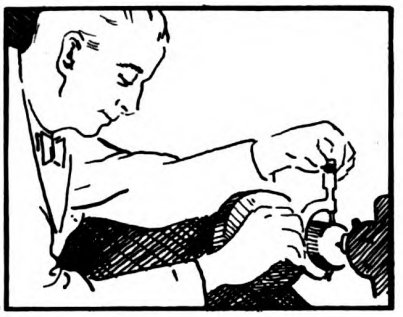

OCCUPATIONAL SKILL AND KNOWLEDGE

	RATING			
	High			Low
	1	2	3	4
Is he highly skilled in his trade or occupation?				
Does he possess a good knowledge of the theory of his trade?				
Does he appreciate the importance of his trade?				
Does his work inspire the trainee to comparable achievement?				
Does he insist on high standards of workmanship?				

QUESTIONING

	RATING			
	High			Low
	1	2	3	4
Do his questions provoke the curiosity and attention of trainees?				
Do they reveal the understanding of the trainees?				
Does he limit each question to one main thought?				
Does he state his questions clearly?				
Does he avoid catch questions?				
Does he give everyone a chance to answer questions?				
Does he encourage the trainees to ask questions?				

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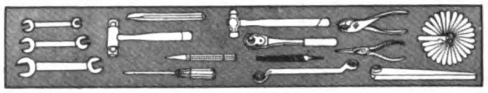

SHOP MANAGEMENT

	RATING			
	High			Low
	1	2	3	4
Is equipment arranged for efficient operation?				
Are tools and equipment kept in good condition?				
Are adequate storage facilities provided for equipment and supplies?				
Are tools properly accounted for?				
Are goggles or shields used when grinding or welding?				
Are dangerous machines provided with guards and are these used?				
Are floors kept free from obstacles which might cause falls?				
Do trainees handle tools safely?				
Are trainees properly dressed for shop work?				
Are fire hazards avoided?				
Are trainees alert about safety practices?				
Are floors kept clean and free of grease?				
Is the shop or classroom kept at proper temperature?				
Is sufficient ventilation provided?				
Is adequate and proper illumination provided?				
Is efficient use made of supplies and equipment?				
Do trainees develop a sense of orderliness?				
Is a progress chart used?				
Are the records and forms well-kept and up-to-date?				
Is good discipline maintained in shop and classroom?				
Does the instructor make periodic inspections of tools and equipment?				
Does he take immediate steps to remedy unsatisfactory conditions?				
Does he secure active co-operation of trainees in maintaining good working conditions?				

INSTRUCTIONAL AIDS

	RATING			
	High			Low
	1	2	3	4
Does he use film strips effectively?				
Does he use films for those situations where they are most useful?				
Does he discuss the film before and after showing it?				
Does he use the blackboard according to recommended procedures?				
Does he use charts, diagrams, and other pictorial material effectively?				
Does he use cutaways, mock-ups, and models effectively?				
Does he use trainee guides, manuals and Technical Orders to best advantage?				
Does he prepare supplementary instruction sheets when needed?				
Does he teach the trainees to use instructional material effectively?				

HUMAN RELATIONSHIPS

	RATING			
	High			Low
	1	2	3	4
Does the instructor command the respect of his trainees?				
Is he courteous and friendly?				
Does he use tact in difficult situations?				
Does he avoid sarcasm and ridicule?				
Is he impartial, treating all trainees fairly?				
Does he rate trainees objectively?				
Does he commend good trainee workmanship?				
Does he co-operate with other instructors?				
Does he co-operate with his superior officers?				

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II. APPRAISAL BY YOUR TRAINEES

When you were in school you probably had a pretty accurate rating of some of your teachers. You heard comments like these from other students, or you made them yourself:

"He plays favorites too much."

"He may be a good mechanic, but he never shows it in the shop."

"She knows her stuff, but she doesn't know how to teach it."

"We study one thing in class, and the exam covers something else."

"Some days, it looks as if he had never opened the book himself before he started the class."

"I'm in the back row and can't hear half of what is said."

"Wish he would talk to us instead of to the blackboard."

Sometimes the comments were of a more favorable nature:

"He always knows what he is going to do in class."

"He works us pretty hard, but we like it."

"I like to work in his shop because everything is always in order."

"He is good at bringing tools and other stuff to class to make things clear."

"I have to ask him a lot of questions, but he always takes time to answer them."

If instructors could see themselves as their trainees see them, possibly they could learn a number of ways to improve their teaching. Suppose that you wanted to know what your trainees thought about your work in shop or classroom. Such ratings from your trainees can be very helpful to you if you are careful to secure their honest opinions. You might give them a rating sheet similar to the one shown earlier in this chapter, and ask them to rate you.

For this purpose, it is most important that they should not sign their names to the rating sheet. Let them know that you want a general appraisal of your instruction from their viewpoint, but that you are not curious about the opinion of any single trainee. Point out to them that unlike handwriting, their check marks do not disclose their identity. Finally, encourage them to take this responsibility seriously by telling them that you have confidence in their good judgment and fairness.

If you have an unusually trustworthy group, you may ask them to include any further comments on the back of the check sheets, but insist that they carefully disguise their handwriting or that they type their comments. Problems that you have never suspected are sometimes brought to light in this way.

Give the trainees an easy way to hand in their check sheets without bringing them directly to you. They may leave them on your desk, or you may ask one responsible trainee to collect them from the others when they are ready.

After all of the check sheets are turned in, you may be tempted to read them through quickly and rely on your general impression of the results. Instead, make a summary sheet showing how many trainees consider you high or low in each item.

A careful study of the ratings by the various trainees may give you important clues toward more effective handling of your many instructional problems.

QUESTIONS

(1) Think back to your days in school and to the best teacher you ever had. Why was this person outstanding?

(2) List five important weaknesses you have observed in your former teachers.

(3) What personal characteristics of an instructor do you consider most important? Give your reasons.

(4) Why is it necessary for a shop instructor to be skilled in his trade?

(5) What teaching skills do you consider most important to good instruction? Give your reasons.

(6) What elements of shop or classroom management do you consider most important?

(7) Make out a rating chart specifically adapted to appraise an instructor in your specialty.

(8) Rate yourself on this chart.

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Chapter 13

THE TRAINING OF WOMEN

The instructor looks at some special problems which arise in training women for mechanical jobs.

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THE TRAINING OF WOMEN

Not long ago, men shook their heads and said it was impossible to produce planes on the assembly line. That women should work on such an assembly line would have been too much to expect. What has happened is even more surprising. Women are not only doing mechanical jobs on production lines, but some of them are doing better work than their predecessors. Because they are competent, many women have become inspectors or supervisors.

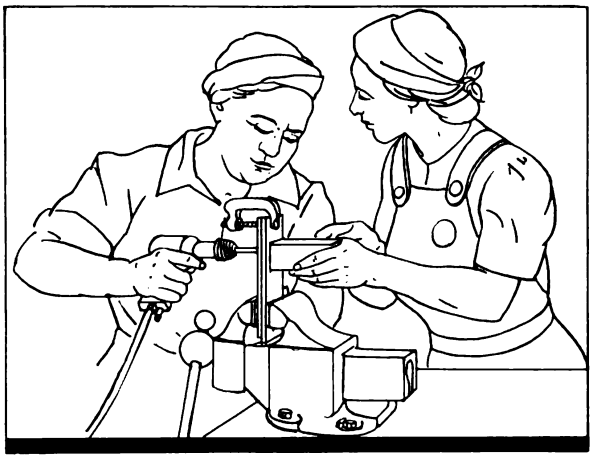

Figure 130—Women workers in aero shop

Such a change in personnel required that industries make a careful study of what women could do and how they could best be trained. In plants where women are most successful, it is likely that their foremen and instructors are well informed about their abilities, their limitations, and their physical and psychological characteristics.

Likewise, your success as an instructor of women may depend on your understanding of them and on your knowledge of the best ways of training them. In this chapter, you will find many helpful suggestions concerned with the special characteristics of women. Nevertheless, it is important to remember that women are people; and as in any group of people, the individuals differ from each other. Some are ambitious, others are lazy; some are competent, others are incompetent; some are flighty, others are steady; some are very strong, others are slight in stature and have considerably less strength.

I. WHAT WOMEN DO WELL

The list of jobs handled by women is constantly growing because of the urgent need for workers, but without question most women are better adapted to some jobs than to others. If you understand what they are likely to do well, you can adjust your training plans to their special needs.

A. JOBS REQUIRING SKILLFUL USE OF FINGERS

You may expect most women to be faster than men in operations requiring the swift and supple movement of the fingers. They have shorter thumbs, but longer and more flexible index fingers than men. Because women are likely to use their hands skillfully on fine work, many of them have been successfully trained as inspectors, assemblers of light machine parts, electrical workers, and riveters. In these and other jobs, training is improved by taking advantage of the special dexterity of women.

Figure 131—Women excel in operations requiring dexterity

B. SIMPLE, ROUTINE OPERATIONS

Perhaps because women are usually inexperienced in industrial work, many of them are satisfied to do simple jobs exactly as they have learned them. They are likely to follow the rules carefully and to report any trouble to the supervisor. Do not be disappointed, then, if your women trainees are content with doing one thing well. They may be inquisitive about that job and want to know why it is done in a certain way. But once it is learned, they may be satisfied not to use their initiative in connection with it.

II. LIMITATIONS OF WOMEN TRAINEES

Once you recognize honestly the exact nature of the limitations of women, you can arrange their training program more efficiently. In addition to the physical and psychological differences between men and women, you need to take into account legal limitations and women's lack of industrial experience.

A. PHYSICAL LIMITATIONS

Women have smaller, less powerful bodies than men. Usually a woman can be expected to lift only one-half as much as a man. Her pulling strength is about two-thirds that of a man. Nevertheless, your training can help her to use her strength most efficiently.

Because a woman's center of gravity is in the pelvis, she handles tools differently from men. For instance,

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she cannot bring as much weight to bear on a screw driver, particularly if she is working at shoulder height. She cannot brace a tool against her chest continuously without danger of physical injury. She should be trained so that her thrust on a rivet gun, for example, comes from the waist line.

B. PSYCHOLOGICAL LIMITATIONS

Women's background and interest in family life affect their attitude toward technical training. They are more easily discouraged and more sensitive to criticism than men. Like most persons, they respond better to praise than to scolding. Many of them are afraid of machines and are bothered at first by the noise and vibration.

The chief interest of your women trainees is likely to be their homes and families. They are concerned about getting their shopping done and caring for their children. You may find them unimpressed by details of fine workmanship and the possibilities of a career in industry. Instead, their goal is to help win the war as quickly as possible. In the meantime, they are more interested in being in a congenial group of persons and in having favorable working conditions than they are in the details of their job.

C. LACK OF INDUSTRIAL EXPERIENCE

If a woman trainee has had no industrial experience, do not be surprised if she has poor co-ordination on the job at first. She is likely to use a vise as awkwardly as the average man uses a needle and thread. She probably does not know the fundamentals of mechanics, nor the names and uses of tools and machines. Hence, related information must be carefully and completely taught.

Without work experience in industry, a woman trainee may lack good work habits. For the same reason, she may be unfamiliar with shop practices and customs. To make up for her inexperience, her training should emphasize the exact practices required on the job in the depot.

D. LEGAL LIMITATIONS

Although the laws differ, the work of women is legally restricted in most states. For example in one state, employers cannot permit women to lift more than 25 pounds; and they must make special provisions for women who stand at their work. Before making plans or changes for the training program in the depot, you should make sure that you are not violating the laws of your state.

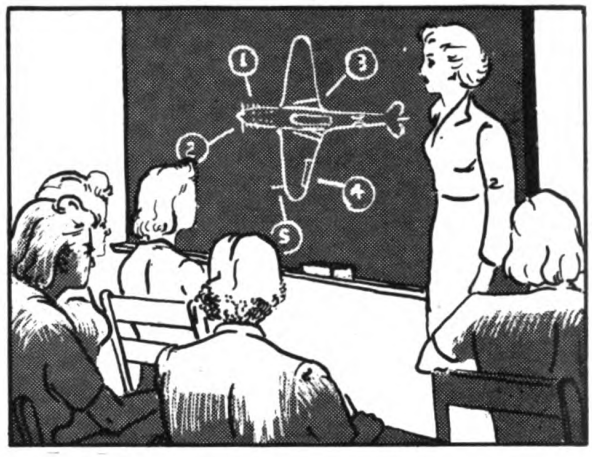

Figure 132—A training group in aircraft nomenclature

III. SUGGESTIONS FOR THE TRAINING OF WOMEN

Here are hints that should help you in your work with women trainees. Many of them are simply sound teaching practices which are particularly useful in dealing with women.

(1) Get off to the right start in teaching women. They are impressionable. The first few hours may establish their attitude toward their work. Be kindly but businesslike; and make them feel that the work they will do is important.

(2) Proceed slowly for about the first two weeks. After they lose their fear of the machines, and after they become accustomed to the noise and vibration, they may be quicker than men in their work.

(3) Help women who have never worked in industry build confidence in themselves. Help them see that they can do the job successfully, that they need not feel "dumb."

(4) Since most women are unfamiliar with terminology, encourage them to ask questions, and give them considerable drill on the names of machines, machine parts, and operations. Use visual instruction—diagrams, pictures, slides, films, actual models, and demonstrations whenever possible.

(5) Orientation should include a trip through the entire shop where the women trainees can see all of the machinery. Explain what each machine does and how it fits into the total picture.

(6) Be friendly with all women workers, but not familiar. Avoid even the appearance of favoritism—women are quick to detect it.

(7) Arrange congenial groupings in the shop. Women of the same background and general interests should be grouped together to get the best results, and older women should be included with young girls to stabilize the group.

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(8) Plan to have patience in teaching women. They cry easily. They cannot stand being "bawled out." They are sensitive to criticism of their work; they are likely to take such comments personally. But experience has shown that women are anxious to do well, are conscientious and appreciative of assistance and instruction.

(9) Women like to know what they are doing and why. If it is not a military secret, give them broader explanations or reasons for their job. Relate it to things they understand. As a woman riveter remarked: "After you catch on to the trick of holding the bar square, you think about that wing and the plane on which it will go and the pilot who will fly it, and how many Japs or Germans he will knock out of the sky."

(10) In your effort to be kind, don't do a woman's work for her or she will become bored. Help her to do it well by herself.

(11) Be interested and enthusiastic over the job. If you are not, the trainees may not be mentally alert and interested.

(12) Recognize that there are differences in individual accomplishment. Check each trainee's work every day to see if she is going too slowly or too rapidly. The hasty ones may be careless; the slow ones may become discouraged.

(13) Avoid long lectures on theory. Remember that women are not interested in this job as a career, but in helping to win the war.

(14) Good housekeeping in the shop, in restrooms, and in lunchrooms helps keep up the morale of the women. Cleanliness of uniforms or work clothes, and personal cleanliness can be encouraged by good restroom facilities—hot and cold water, good soap, enough towels, mirrors. Make reasonable rules about the use of the restroom, and the women will abide by them. If good conditions prevail, 10 minutes of rest at the end of a 2-hour stretch of work is enough.

(15) Accept women's interest in dress realistically. Some dress to kill; others are more interested in utility. All need to understand why certain recommended garments are safe and suitable if they are to adhere to the regulations.

(16) Women need more safety instruction than men because of their lack of familiarity with tools and machines. Relate such instruction to experiences they understand. Once they understand the regulations, they are careful. Their safety records are higher than those of men.

(17) Always seek ways of making the work light. If any lifting is necessary, teach the women how to use the leg muscles and large muscles in the back. Look for labor saving devices. Encourage them to find short cuts, to lift easily, to use levers. At many jobs, they can increase their output by alternating sitting and standing positions.

(18) Women should be encouraged to eat a well-balanced lunch, including something hot. The lunch period should be not less than 30 minutes.

(19) An instructor should be tactful, wise, and understanding in his treatment of women trainees. He should be able to soothe ruffled feelings, as well as to administer first aid. Women are inquisitive and willing to learn. For a competent and tactful instructor, they will be conscientious in their learning.

IV. SPECIAL PROBLEMS IN THE TRAINING OF WOMEN

Certain aspects of instruction are specially important in dealing with women trainees. It is not enough for you to recognize and deplore certain traits of women; you should be able to handle their limitations constructively.

A. LIMITED PHYSICAL STRENGTH

Without encouraging laziness, you can teach women how to avoid extra muscular effort, stretching, and climbing. For example, a woman who has difficulty in loosening the handle of a vise can be advised to use a mallet. Step ladders, stands, and platforms should be available so that women can stand within easy reach of their work. Whenever possible, equipment should be suspended from counterbalances to eliminate lifting.

These suggestions and devices not only make the work easier, but they also increase the efficiency of the women trainees.

B. SENSITIVITY TO CRITICISM

If you are tactful in making suggestions and corrections, you can prevent most of the women trainees from becoming emotional over their shop or classroom problems. But you need not protect them from all criticism, since their training should prepare them to accept responsibility on the job.

When a woman trainee becomes troublesome and does not respond to kindly suggestions, you should handle the situation firmly. First, make sure that she deserves a reprimand, and then arrange to talk to her in private. Point out her mistakes soberly, but never angrily. Be direct, but tactful and polite. Show her how to improve her work, and allow her to save face if possible.

C. FEMININE WILES

Some women may seek to distract male employees, or to put the instruction on a basis of male gallantry and feminine coyness. This effort will fail if you are always courteous and kindly, but impersonal. Keep the

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distance of your authority without being severe. Praise the *work* when it deserves to be praised, but not the individual worker if she is likely to consider it a personal compliment. Since some women get more satisfaction from being praised than from doing a good job, you must carefully build up their pride in their work.

After the women are accustomed to the training and the new work, give them no special privileges other than those relating to physical limitations. They should be held to the same standards as the men being trained for the same jobs.

D. ABSENTEEISM

You can prevent absenteeism more easily than you can cure it once the women are in the habit of taking a day off occasionally. Plan your training so carefully that they never get the feeling that it does not matter whether they are in class or not. If they feel that they have missed something, that their progress is delayed by absence, they will arrange their affairs so that they can attend regularly. Problems of shopping and household management are often difficult for them, but they must face the necessity of getting outside help for the home if they are to combine homemaking and a full-time job successfully.

E. WOMEN'S CLOTHES AND SAFETY

While some women may be perverse in the matter of wearing appropriate clothes, most of them co-operate well once they understand *why* they are asked to wear close-fitting clothing, low-heeled shoes with closed toes, and head-coverings. They can be helped to imagine vividly the injury that would result if a sweater or a flapping sleeve, belt, or pocket caught on the rotating part of a machine. Most of them will agree that jewelry, long, flowing hair, and high heels are not only dangerous but inappropriate. After you are sure they understand what they are to wear and how their clothing concerns their safety, notice their clothing quietly and unobtrusively. Whenever a woman trainee appears in high heels, or with flowing hair, or in some other way exposes herself to danger, call her aside and ask her to correct the situation before she starts to work among the machines.

You may need to make certain concessions to women's habits of dress. Some of them may do better work if they can reassure themselves that they look well. A woman who takes a swift glance into a mirror to make sure that her nose is powdered may attend to her work more enthusiastically than if she were wondering how she looks. As long as they do not waste too much time, you are wise not to make an issue of their concern with their appearance. Also, they will probably insist upon carrying fairly large purses to classroom or shop. You

can avoid any difficulty if individual lockers are available. If not, insist that women trainees take their handbags with them when they leave the room.

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F. WOMEN'S GRIEVANCES

You may be unimpressed with certain aspects of the job which seem very important to women. They may complain about dirty washrooms or restrooms, lack of mirrors, inconvenient eating facilities, and hot, moist working conditions. Since criticisms of this sort may spread through the shop and later discourage women in the community from accepting work at the depot, you should take the criticisms seriously. If they are valid, you should report the problem to the proper authority.

Some women are discouraged if they do not make quick progress in their training, or they dislike their working companions, or they resent the advancement of one of their fellow workers. Such a trainee should be placed with women at the same stage of learning. Show her the standards she must achieve before she can be advanced, and help her to increase her skill. Make it a policy to have different trainees work together from time to time in order to keep them from forming cliques and from suspecting favoritism on your part.

G. THE MISFIT

Although some women can take over men's jobs with very little adjustment, many of them need your thoughtful consideration. Occasionally, you may decide that a woman is a misfit, that she probably will not benefit by your training, and that she should be transferred to another specialty. Instead of dismissing her unceremoniously, talk to her about her past experience. Find out if her previous jobs required manipulation, alertness, keen eyesight, or skill but limited strength. Ask her if she has been accustomed to office work or to the operation of large machines. When you have this information at hand, you can suggest another sort of training at the same time that you advise her to abandon the specialty you represent.

V. NOTES TO WOMEN INSTRUCTORS

Tact in correcting mistakes and thoughtfulness for the trainees' welfare are perhaps more important for women instructors than for men. Your relationship with your trainees will probably be successful if you keep in mind the way you like a woman instructor to help you to learn.

You might as well begin by accepting as a challenge the resentment that you may sense among your trainees. The best way to counteract their skeptical attitude is to know your material thoroughly. Never be slipshod in your preparation, lest they catch you in an inexcusable error. On the other hand, do not pretend that you know more than you really do. Let your trainees know that you, too, are eager to learn, and that you welcome a chance to discover or to help them find out new things. If some of your trainees have had industrial experience in a field related to your specialty, show your interest in it, but do not permit their contributions to monopolize your classroom work.

If you are conscientious and fair and honest, your trainees will soon respect you. Being a particularly efficient instructor is the best way of avoiding their criticism.

QUESTIONS

(1) What *special abilities* of women would be particularly advantageous in your training course?

(2) What *limitations* of women will be especially important in your training course?

(3) Look over a lesson plan you have already made, and list any changes which would be necessary if the trainees were women.

(4) What would you suggest to the woman who insists that she can take care of her home and children and still do full-time work at the depot?

(5) What are the important differences between instructing men and instructing woman trainees?

(6) If you are a woman instructor, make a list of the most important points to remember in dealing with trainees in your particular field. Give examples when possible.

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